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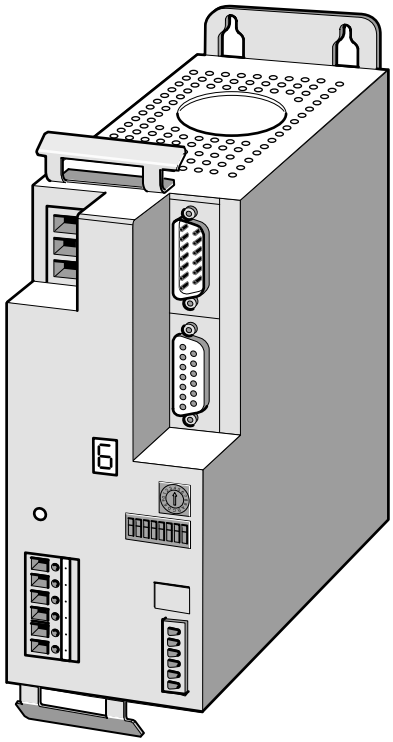
Telemecanique

by Berger Lahr

Technical documentation



Twin Line Drive 01x

Drive for stepper motors

TLD01x

Operating system: 1.0xx

Order no.: TLADOCD01ME

Edition: -002, 12.02

Twin Line™

Motion Products

TLD01x General Hazard Statement

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION

- Read and understand this bulletin in its entirety before installing or operating Twin Line drive system products. Installation, adjustment, repair, and maintenance of these drive systems must be performed by qualified personnel.
- Disconnect all power before servicing the power controller. WAIT SIX MINUTES until DC bus capacitors discharge, then measure DC bus capacitor voltage between the DC+ and DC- terminals to verify that the DC voltage is less than 45 V. The DC bus LED is not an accurate indication of the absence of DC bus voltage.
- The motor can produce voltage at its terminals when the shaft is rotated! Prior to servicing the power controller, block the motor shaft to prevent rotation.
- DO NOT short across DC bus terminals or touch unshielded components or terminal strip screw connections with voltage present.
- Install all covers and close enclosure door before applying power or starting and stopping the drive system.
- The user is responsible for conforming to all applicable code requirements with respect to grounding all equipment.
- Many parts in this drive system, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.

Before servicing drive system:

- Disconnect all power.
- Place a “DO NOT TURN ON” label on the drive system disconnect.
- Lock the disconnect in open position.

Failure to follow these instructions will result in death or serious injury.

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Glossaries

Abbreviations

Abbreviation	Meaning
AC	Alternating current
DC	Direct current
E	Encoder
E.l.c.b.	Earth leakage circuit-breaker
EG	European Community
EMC	Electromagnetic compatibility
EN	European Norm
EU	European Union
I/O	Input / output
Inc	Increment
IT system	I: isolated; T: terre (Fr.), ground. Power system with no connection to ground, not earthed
LED	Light-Emitting Diode
M	Motor
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Agency
PELV	Protective Extra-Low Voltage
PLC	Programmable logic controller
RC	Residual current

Product name

Abbreviation	Product designation	Term used
TL HBC	Twin Line Holding Brake Controller	Holding brake controller
TLD01x	Twin Line Drive 01x	Drive

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Technical Terms

Actual position of the drive system	The actual position of the drive system gives the absolute or relative positions of driven components in the system.
Actual position of the motor	See Angular position of the motor.
Angular position of the motor	The angular position of the motor corresponds to the angular position of the rotor in the motor housing, and is referenced to the zero point or index point of the position sensor.
DC-Bus	The DC-bus generates the necessary direct current for operating the motor and provides the amplifier with the necessary energy. The DC-Bus acts as a buffer to energy fed back by the motor.
Direction of rotation	Rotation of the motor shaft in a clockwise or counter-clockwise direction. A clockwise direction of rotation is given when the motor shaft rotates clockwise as the observer faces the end of the protruding shaft.
Drive solution	The drive solution comprises the drive system with its Twin Line drive and motor, as well as the system mechanics forming an integral part of the chain of motion.
Drive system	The drive system consists of the Twin Line unit and the motor.
Encoder	Sensor for recording the angular position of a rotating element. The encoder is mounted on the motor and signals the angular position of the rotor.
High/open	Signal status of an input or output signal; when no signal is present, signal voltage is high (high level).
Incremental signals	Angular steps of an encoder in the form of square-wave pulse sequences. Relative changes in position are signalled by the number of pulses contained in the pulse sequence.
Index pulse	Encoder signal for referencing the rotor position in the motor. The encoder sends one index pulse per revolution.
IT network	Power system with no connection to ground I: isolation; T: terre (French): ground.
Limit switch	Switches which signal any overrun on the permissible travel.
Low/open	Signal status of an input or output signal; when no signal is present, signal voltage is low (low level).
Power amplifier	This is the unit that controls the motor. The power amplifier generates currents for controlling the motor in accordance with the signals from the control unit.
Power controller	See Power amplifier.
PULSE-C	Pulse direction interface for recording external position presets via pulse direction signals or $Pulse_{forward}$/$Pulse_{backward}$ for the positioning of the motor.
Pulse direction signals	Digital signals with variable pulse frequencies which signal changes in position and rotation direction via separate signal wires.
RS-422 level	The signal status is calculated from the differential voltage of one positive and one inverted negative signal. Two signal wires must therefore be connected for one signal.
Sense regulation	The voltage drop on the supply lines is compensated in such a way that the output voltage at the sense terminals has the correct value. The output voltage is only activated once the sense lines have been connected.

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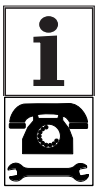
Speed monitoring Detects position deviations during motor movement. The actual position reported by the encoder is compared with the setpoint position. If the deviation exceeds a defined value, a following error is reported.

Watchdog Device in the unit which detects internal faults. If a fault occurs, the amplifier is switched off immediately.

Written conventions and note symbols

Action symbols "▶" This action symbol is used for step-by-step instructions which can be carried out as they are described. If one of the instructions leads to a noticeable response from the unit, this will be given after the description of the action to be carried out. In this way you will receive direct confirmation that a particular step has been correctly carried out.

Enumeration symbol "•" The enumeration symbol is used for listing individual points in a given information group in summary form. If the result of steps or sequences is described, the step to be carried out is described first.



This symbol is used for general notes which give additional information about the unit.

Passages which are preceded by this symbol may have to be discussed in more detail with Schneider Electric's customer service. Refer to "Service Information", page 8-1 for contact information.

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1 The drive

1.1 Scope of supply

▶ Check the parts supplied to make sure they are complete.

Keep the original packaging in case the unit has to be returned to the manufacturer for an update or repair.

Scope of supply of drive

The scope of supply of the TLD01x drive includes:

Item	Qty.	Designation	Order no.
1	1	TLD011, TLD012	See Fig. 1.1
2	1	Hood for front cover	-
3	1 or 2	SK 14 shielding terminal for motor connection	TLATE
4	1	Plug units for terminal strips	-

Optional equipment of the drive:

Item	Qty.	Designation	Order no.
1	1	TLD01x without speed monitoring	See Fig. 1.1
1,5	1	TLD01xxD without internal filter	See Fig. 1.1

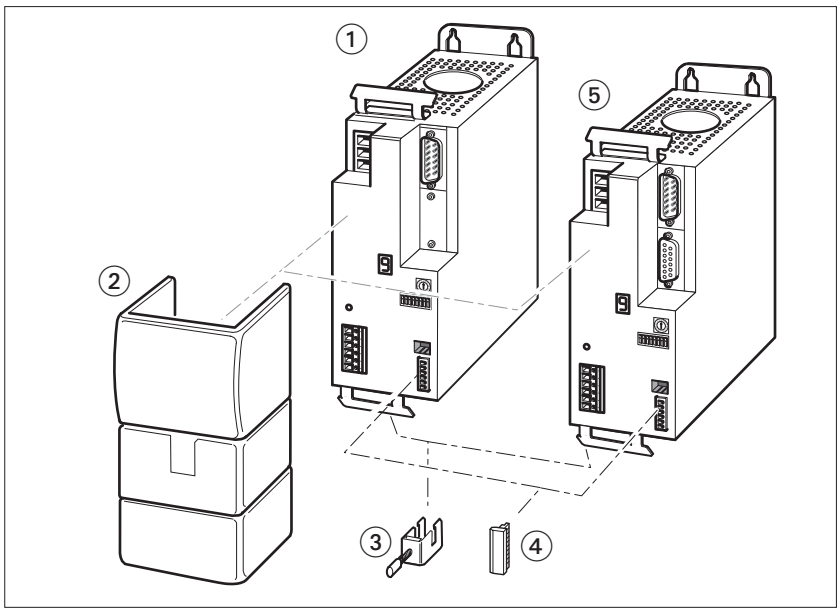

Fig. 1.1 TLD01x without and with speed monitoring

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Accessories Accessories for the drive are:

Item	Qty.	Designation	Order no.
1	1	Connector set for complete assembly	TLATF
2	1	Motor cable 1.5 mm^2.	TLACPVAAxxx1 [1)]
-	1	Pulse direction cable for PULSE-C interface 2 x socket, 15-pin 1 x socket, 15-pin, one end open	 TLACDCBByyy [2)] TLACDCAByyy [2)]
3	1	Encoder cable for encoder interface with SUB-D connector at both ends	TLACFVBAxxx1 [1)]
4	1	Holding brake controller TLHBC	TLABHO
-	1	External mains filter for units without internal filters TLDx11D\TLDx12D	Please contact your local Schneider Electric office

1) Cable length xxx: 003, 005, 010, 015, 020: 3 m, 5 m, 10 m, 15 m, 20 m, greater lengths on request. Please contact your local Schneider Electric office.
2) Cable length yyy: 005, 015, 030, 050, 100: 0.5 m, 1.5 m, 3 m, 5 m, 10 m.

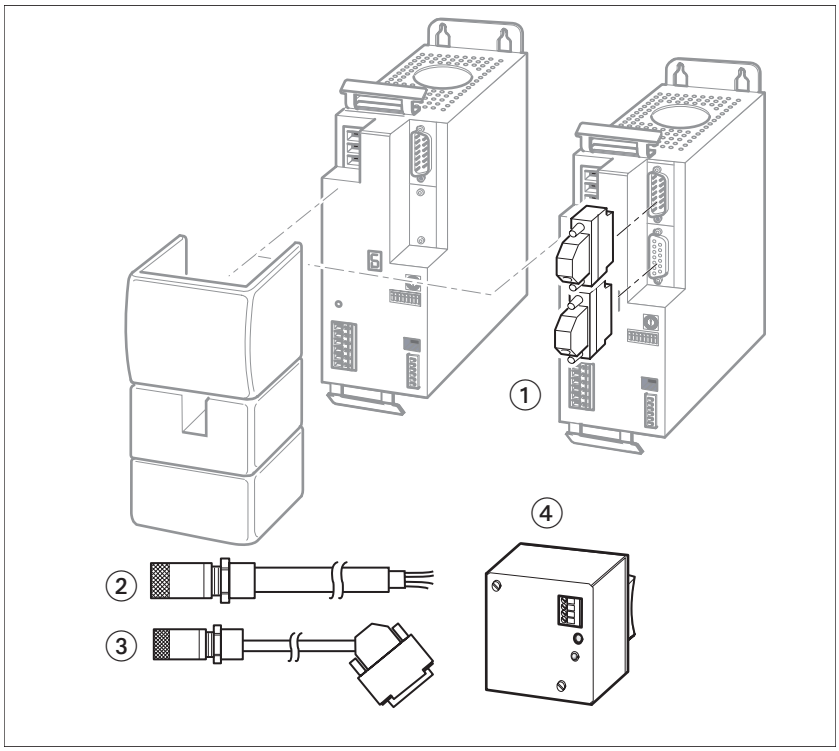

Fig. 1.2 Accessories for the TLD01x

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1.2 Unit series

The drive TLD01x forms part of the Twin Line device series for controlling stepper motors and AC steppers. The drive operates as a stand-alone power amplifier with integrated controller and power circuitry.

The drive is available with two power ratings in a similar housing design. Electrical connections and functional scope are identical for both units.

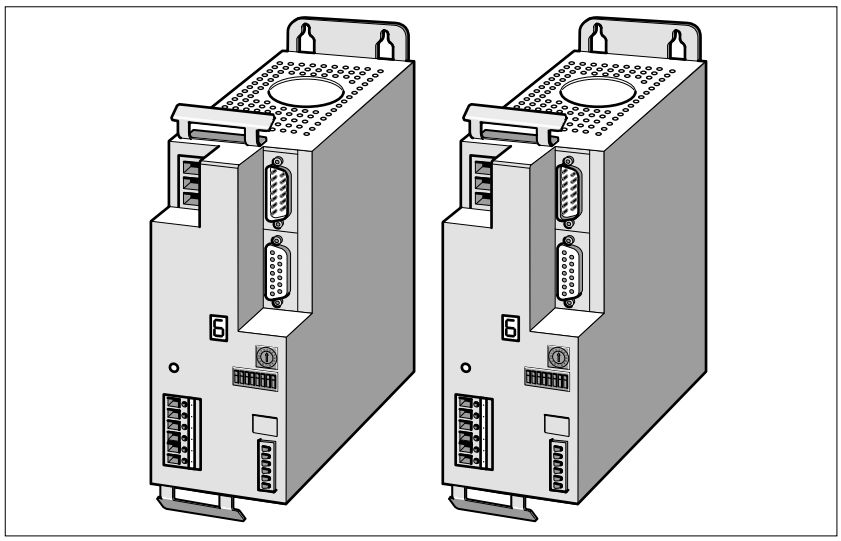

Fig. 1.3 Drive TLD011 and TLD012

Type code The power class of the drive is indicated by the last digit in the device name "TLD01x" of the type code.

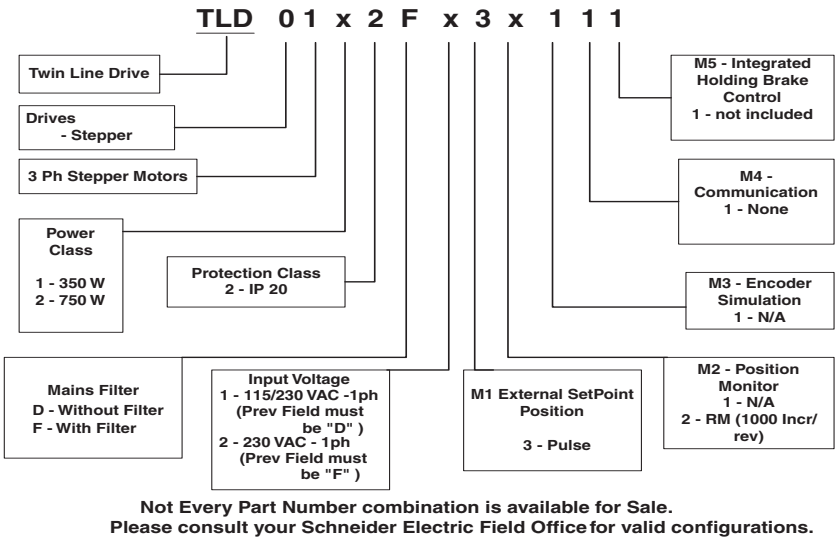

Fig. 1.4 Type code of the drive TLD01x

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1.3 Drive overview

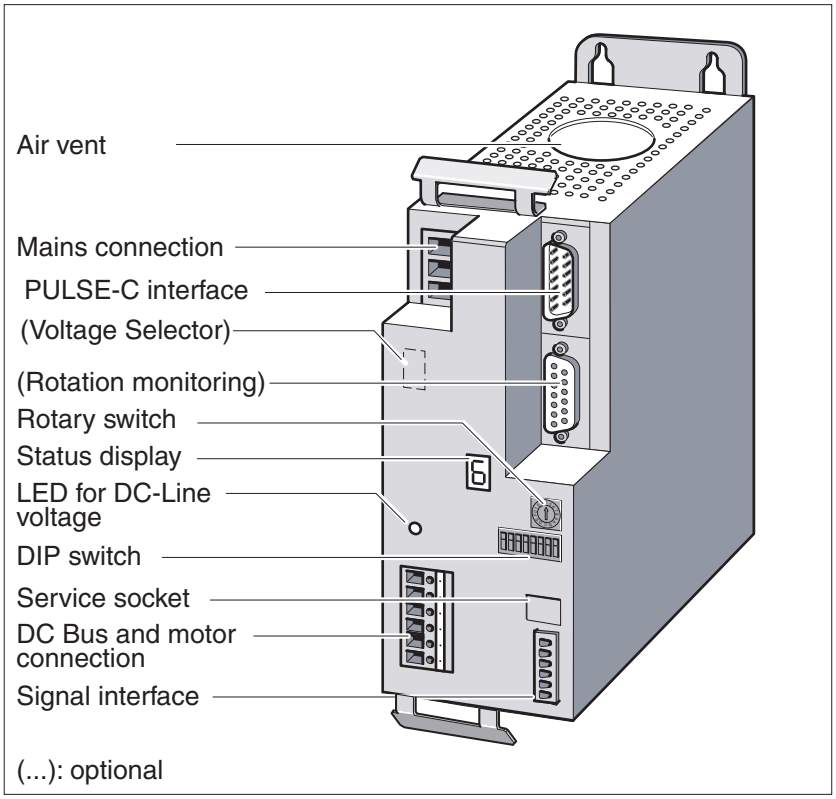

Fig. 1.5 Drive TLD01x

Mains connection The power supply for the amplifier is connected to the line power output. A drive with a built-in line power filter can be operated without any further noise suppression on the supply side.

Motor connection The unit supplies the power for a stepper motor over the three-phase connection. The maximum power output is monitored by the unit. The motor connection is short-circuit protected and is checked for ground faults when the amplifier is enabled.

DC-Bus connection The DC link voltage for the unit is taken from the intermediate circuit terminal. The capacity of the built-in DC-link capacitors at the DC-link connection can be increased with external capacitors for short-term absorption of excess braking energy.

PULSE-C interface The setpoint position is set incrementally as a pulse signal over this interface. Control signals for enabling the power amplifier, changing the step resolution and the current setpoint value are also sent over the interface.

Output signals at the PULSE-C interface report a fault and that the unit is ready for operation.

Speed monitoring The drive receives A/B signals for position monitoring of the stepper motor and a signal that checks the motor temperature. The encoder electronics in the motor receive the required operating power from the speed monitoring connection.

Speed monitoring is built into the system as an option.

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Voltage selector switch The unit can be connected to 115 V or 230 V power with the voltage selector switch. The voltage selector switch is only available with units without mains filters (D option).

Signal interface The power for control loops and for controlling the fan must be supplied over the signal interface by an external 24 V_{DC} power supply. The lines for a holding brake or the control lines for the TL HBC holding brake controller are connected to the brake terminal.

Status display A 7-segment display shows information about the operating status of the drive. If there is an operating malfunction the display will flash and display the error code.

DIP switch The step resolution and the controller signal functions are set by the eight DIP switches.

Rotary switch The rotary switch limits the maximum motor r.m.s current. The value for the maximum motor current is shown in the motor type plate.

LED for DC-Bus voltage The LED comes on when there is voltage in the DC-Bus.

Air outlet and fan A built-in fan extracts cold air from the bottom of the unit and removes the unit operating heat through the upper air vents. Temperature sensors on the power amplifier's heat sink protect the unit from overheating.

Circuit diagram

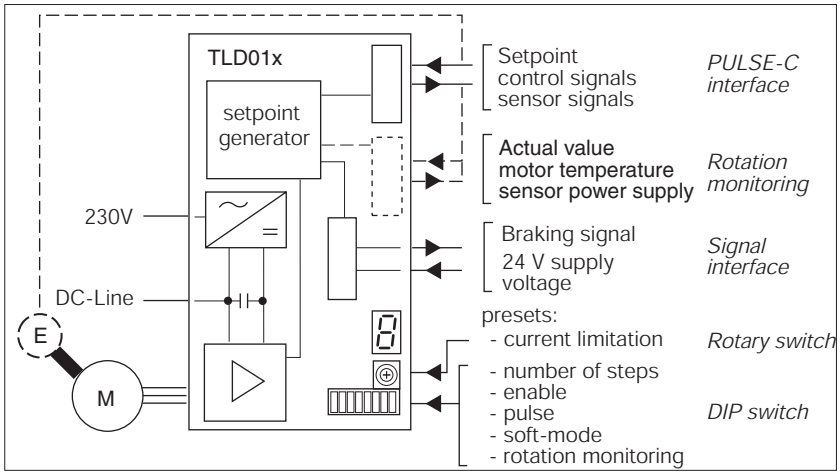

Fig. 1.6 Signals and function blocks of the drive with speed monitoring

1.4 Operational function

The drive moves a stepper motor in accordance with a setpoint. The setpoint signal is generated by a positioning or NC controller and fed to the PULSE-C interface as a pulse signal.

If speed monitoring is also installed, the drive records the position of the motor and reports step losses, which may occur as a result of blocking or overload of the motor.

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1.5 Guidelines and standards

1.5.1 Declaration of conformity and CE mark

The EC directives define the minimum requirements - particularly safety requirements - applicable to a product and must be complied with by all manufacturers and dealers marketing the product in the member states of the European Union (EU).

The EC directives describe the main requirements for a product. The technical details are laid down in the harmonized standards, which are published in Germany as the DIN EN standards. If there is not yet any EC standard applicable to a particular product area, existing technical standards and regulations will apply.

CE mark

With the declaration of conformity and the CE mark on the product the manufacturer certifies that the product complies with the requirements of all relevant EC-directives. The unit can be used anywhere in the world.

Machine Directive

The Twin Line unit is not a machine in the sense of the EC Machine Directive (89/392/EEC). It has no functional moving parts. The unit may however be a component part of a machine or installation.

Provided the rest of the machine complies with the machine directive and it has been set up in accordance with the EMC testing code of the manufacturer, conformity with the machine directive can be certified.

EMC Directive

The EC directive on electromagnetic compatibility (89/336/EEC) applies to units which can cause electromagnetic interference or whose operation can be impaired by such interference.

The Twin Line unit’s compliance with the EMC Directive cannot be assessed until it has been installed into a machine or installation. The instructions provided in “Installation” must be complied with to guarantee that the Twin Line unit is EMC-compliant when fitted in the machine or installation and before use of the unit is permitted.

Low Voltage Directive

The EC Low-Voltage Directive (73/23/EEC) lays down safety requirements for "electrical apparatus" as protection against the risks that can originate in such devices and can be created in response to external influences.

As specified by the low voltage directive the Twin Line unit conforms to EN 50178 and to the following peripheral conditions:

- protection class 1
- pollution degree 2

Declaration of conformity

The declaration of conformity certifies that the device satisfies the requirements of the EC directive cited. A declaration of conformity in accordance with the EC low-voltage directive has been issued for the Twin Line unit.

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EC Declaration of Conformity 2001

BERGER LAHR

BERGER LAHR GmbH & Co.KG
Breslauer Str. 7
D-77933 Lahr

☐ Machine Directive 98/37/EEC, Appendix IIA
☒ EMC Directive 89/336/EEC
☒ Low Voltage Directive 73/23/EEC
the above directives have been amended by the CE Marking Directive 93/68/EEC

We hereby declare that the products designated below correspond, in their design and construction as well as in the version marketed by us, to the requirements of the listed EC directives. This declaration loses its validity if changes are made to the products which have not been agreed with us.

Designation:	3-phase motor amplifiers with/without electronic control and accessories
Part number:	TLDx1x2…, TLCx1x2…, TLDx3x2…, TLCx3x2…, TLCx1x5…, TLCx3x5…,TLABH…, TLABB…
Material number:	01634xxxxxxxx, 01635xxxxxxxx, 0162501101706, 0162501101606
Harmonised norms applied, especially:	EN 50178 Classification VDE 0160: 1998.04 EN 61800-3 Classification VDE 0160: 1997.08, category 2 according to BERGER LAHR test conditions
national norms and technical specifications applied, especially:	UL 508C BERGER LAHR test conditions 200.47-01 EN
Company stamp:	Berger Lahr GmbH & Co. KG Postfach 11 80 · D-77901 Lahr Breslauer Str. 7 · D-77933 Lahr
Date/Signature:	15. Nov. 2001
Name/Department:	W. Brandstätter / MOM-E

Fig. 1.7 Conformity to the EC low-voltage directive

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1.5.2 Regulations and standards

Standards concerning recommended installation, operation, maintenance, repair, and adjustment of the Twin Line drive system	EN 60204 - Part 1: 1999: Electrical equipment of machines, General requirements
	NFPA 70: 1999: National Electrical Code
	NEMA ICS1.1: Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control
	NFPA 79: 1997: Electrical Standard for Industrial Machinery
	EN60529: 2001: Degrees of protection provided by enclosures (IP Code)
	EN61508-1: 1998: Functional safety of electrical / electronic / programmable electronic safety-related systems, Part 1: General design principles
	IEC 61131-3, Programmable controllers—Programming languages
	NFPA 70E: 2000: Standard for Electrical Safety Requirements for Employee Workplaces
	NEMA ICS7.1 Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable-Speed Drive Systems
Standards regarding compliance with EMC Directive	EN 61000-4-1: 2000: Testing and measurement techniques–Overview of IEC61000-4 series (noise immunity testing procedures)
	EN 50082-2: 1995: Electromagnetic Compatibility–Generic immunity standard–Industrial environment
	EN61800-3: 1996: Adjustable speed electrical power drive systems–EMC product standard including specific test methods
	EN61000-4-5: 2001: Electromagnetic compatibility (EMC)–Testing and measurement techniques–Surge immunity test
Standards regarding compliance with Low Voltage Directive	EN50178: 1997: Electronic Equipment for use in Power Installations
	EN60664-1: 2000: Insulation coordination for equipment within low-voltage systems–Principles, requirements, and tests
Standards regarding compliance with Underwriters Laboratories requirements	UL508C 2nd Edition: UL Standard for Safety for Power Conversion Equipment
	UL840 2nd Edition: UL Standard for Insulation Coordination Including Clearances and Creepage Distances for Equipment
	UL1004 5th Edition: UL Standard for Safety for Electric Motors

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2 Safety

2.1 Hazard categories

Safety notes and general information are indicated by hazard messages in the manual. In addition there are symbols and instructions affixed to the Twin Line controller that warn of possible hazards and help to operate the controller safely.

Depending on the seriousness of the hazard, the messages are divided into three hazard categories. The symbols shown emphasize the degree of hazard present.

DANGER

⚠ DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, **will result** in death or serious injury.

WARNING

⚠ WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, **can result** in death or serious injury.

CAUTION

⚠ CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can result** in minor or moderate injury.

CAUTION

CAUTION, used without the safety alert symbol, indicates a potentially hazardous situation which, if not avoided, **can result** in property damage.

The signal word is followed by a statement of the hazard (for example, electric shock) and may be accompanied by a pictogram depicting the hazard or additional descriptive information concerning the hazard.

Following the statement of hazard is information on how to avoid or mitigate the hazard.

The last portion of the hazard message states the consequences of failure to follow the information contained in the hazard message.

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2.2 Safety instructions

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION

- Read and understand this bulletin in its entirety before installing or operating Twin Line drive system products. Installation, adjustment, repair, and maintenance of these drive systems must be performed by qualified personnel.
- Disconnect all power before servicing the power controller. WAIT SIX MINUTES until DC bus capacitors discharge, then measure DC bus capacitor voltage between the DC+ and DC- terminals to verify that the DC voltage is less than 45 V. The DC bus LED is not an accurate indication of the absence of DC bus voltage.
- The motor can produce voltage at its terminals when the shaft is rotated! Prior to servicing the power controller, block the motor shaft to prevent rotation.
- DO NOT short across DC bus terminals or touch unshielded components or terminal strip screw connections with voltage present.
- Install all covers and close enclosure door before applying power or starting and stopping the drive system.
- The user is responsible for conforming to all applicable code requirements with respect to grounding all equipment.
- Many parts in this drive system, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.

Before servicing drive system:

- Disconnect all power.
- Place a “DO NOT TURN ON” label on the drive system disconnect.
- Lock the disconnect in open position.

Failure to follow these instructions can result in death, serious injury or equipment damage.

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⚠WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of the control signal paths and, for certain critical control functions, provide a means to achieve a safe state during and after a signal path failure. Refer to NEMA ICS1.1 *Safety Guidelines for the Application, Installation and Maintenance of Solid State Control* and NEMA ICS7.1 *Safety Standards for construction and Guide for Selection, Installation and Operation of Adjustable –Speed Drive Systems* for further information
- Separate or redundant control paths must be provided for critical control functions.
- System control signal paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failure of the link.

Failure to follow these instructions can result in death, serious injury or equipment damage.

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2.3 Use for the purpose intended

2.3.1 Ambient conditions

Ambient temperature	0 °C to +50 °C
Transport and storage temperature	-40 °C to +70 °C
Relative humidity	15% to 85% (no condensation permissible)
Installation height, operation with no reduction in performance	h<1000 m above m.s.l.
Vibration stress during operation to DIN IEC 68-2-6	
Number of cycles:	10
Frequency range:	10Hz to 500Hz
Acceleration:	20m/s^2
Continuous shocks to DIN IEC 68-2-29	
Number of shocks:	1000/direction (X,Y,Z for each clockwise, counter-clockwise direction, total 6000)
Peak acceleration:	150m/s^2
Protection grade	IP20

2.3.2 Intended use

The drive is an electrical device for controlling a variable-speed drive with stepper motor.

Only VRDM stepper motors may be operated with the drive. The motor must be approved by your local representative for operation with the unit.

The motor connections of multiple units may not be connected to each other.

Multiple units must not be connected in parallel over the DC-link output.

The drive may be used for industrial applications in the system configuration described with a fixed connection only.

The drive may only be set up and operated after correct EMC installation.

The drive must be installed and properly mounted in a switch cabinet. It may only be used with the cables and accessories specified by your local representative.

The drive may not be used in ungrounded delta networks, as they have no ground potential. Interference suppression filters for correct EMC installation will only work properly with a ground potential connection.

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2.3.3 Suitability in safety critical applications

Twin Line products are designed for general-purpose motion control. These products are intended for integration into machine control systems where the machine safety considerations have been addressed by the system design. Examples of such methods include, but are not limited to, apparatus selection, system configuration, guarding or by warning.

Unless stated in the product specifications, **the Twin Line product has not been evaluated for control of safety critical machine functions. Direct application of this apparatus to a safety critical function can create a hazard to personnel and property.** Prior to considering this equipment for operation of safety critical control functions, engineering evaluation for suitability is required.

Should questions arise concerning the suitability of this apparatus for a specific application, contact Schneider Electric.

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2.4 Qualification of the personnel

Work on and with the drive may only be carried out by qualified personnel.

Qualified personnel can use their technical training, knowledge and experience to assess the work to be done and to recognize and avoid possible hazards.

Qualified personnel will be aware of the current standards, regulations and accident prevention regulations which must be observed when working on the drive system.

2.5 Safety devices

The drive unit monitors a range of signals from system and installation components.

Safety devices coupled with the unit protect the system and operating personnel. The following components and limit values are monitored internally:

Monitoring	Task and protective functions
Short-circuit	Monitor motor cable for short-circuits between phases, functional safety and device protection
Overvoltage and undervoltage	Monitor DC link for overvoltage and undervoltage, functional safety and device protection
Temperature	Monitor power amplifier and motor [1)] with sensors for excess temperature, device protection
Speed error	Following error indicated in units with speed monitoring if position deviation is too great, functional safety

1) Motor monitoring only with devices with optional speed monitoring

⚠WARNING

LOSS OF BRAKING TORQUE

- No holding torque is available during loss of power or drive controller fault.
- When required (i.e., for protection of personnel), use a separate braking function for holding torque. Refer to NEMA ICS7.1 *Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable - Speed Drive Systems* for additional information.

Failure to follow these instructions can result in death, serious injury or equipment damage.

TLADOCD01ME, -002, 12.02

3 Technical data

3.1 Mechanical data

3.1.1 Drive TLD01x

Weight TLD011 and TLD012 with speed monitoring 2.2 kg (4.85 lb.)

Device protection Protection grade to DIN EN 60529: 1991 open (IP 20)

Dimensions

	TLD01x
Width	81 mm (3.19 in.)
Height	212.5 mm (8.37 in.)
Depth	184.5 mm (7.26 in.)

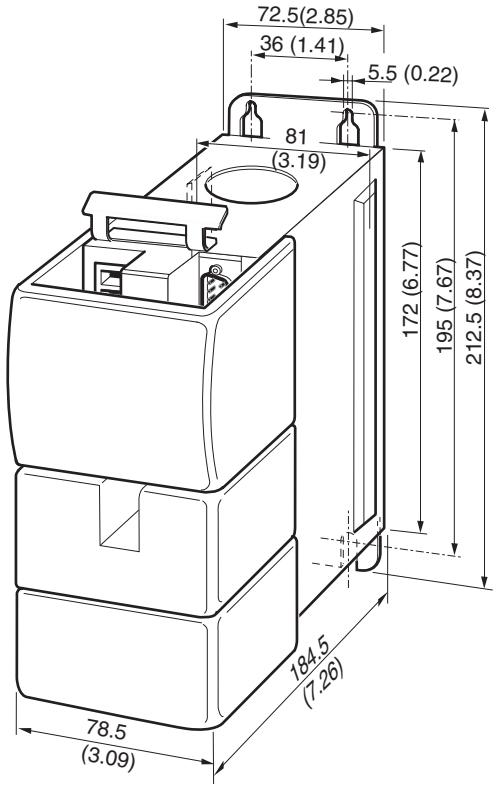

Fig. 3.1 Dimensions TLD011 and TLD012 in mm (in.)

3.1.2 Accessories

Holding brake controller TL HBC	Dimensions (H x W x D)	107 mm x 104 mm x 76 mm (4.3 x 4.2 x 3.0 in)
	Installation on top-hat rail	55 mm 2.165 in)

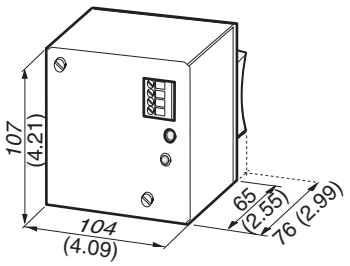

Fig. 3.2 Holding brake controller

TLADOCD01ME, -002, 12.02

3.2 Electronic data

3.2.1 Drive

Line connection

	TLD011	TLD012
Line voltage [V_{AC}] only with TLD01xD:	1 x 230 -20%/+15% 1 x 115 -20%/+15%	1 x 230 -20%/+15% 1 x 115 -20%/+15%
Line frequency [Hz]	47 - 63	47 - 63
Current consumption [A]	2 (230 V) 4 (115 V)	5 (230 V) 10 (115 V)
Starting current [A]	< 60	< 60
Power factor cosφ	> 0.6	> 0.6
Power loss [W]	≤ 40	≤ 60
Line buffering [ms]	< 5	< 5
Operational overvoltage (EN61800-3 and EN61000-4-5)	between phases: 1 kV; phase to earth: 2 kV	
Input mains overvoltage category (UL840)	cateogry III [1]	
Leakage current [2] [mA]	< 30	< 30
Fuse, external [A] / characteristics at 230 V at 115 V	 10 (Class CC) 10 (Class CC)	 10 (Class CC) 10 (Class CC)

1) The Twin Line family of products has been designed according to standard UL840. Installation of a surge arrestor on the branch circuit supplying power to the Twin Line drive is recommended. Use Schneider Electric SDSA surge arrestor or equivalent.
2) Leakage currents are measured with an RC circuit in accordance with IEC60990. The value can be higher if measured directly. Notes on using ground leakage circuit-breakers on request.

Motor connection

	TLD011	TLD012
Power class [1] [kW]	0.35	0.75
Switching frequency [kHz]	16	16
Rated current [A.r.m.s.], r.m.s.	3	7
Max. speed [rpm]	3000	3000
Cable length [2] [m]	20	20
Cable cross-section [mm^2]	1.5	1.5

1) Max. electrical effective power of the unit at rated current and 115 V_{AC} or 230 V_{AC} line voltage
2) Longer cables on request. Please contact your local Schneider Electric office.

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24 Vdc supply

24 Vdc (+) to 0 Vdc (-) [Controller Terminals S31–32(+) to S33–34(-)]	
Function:	Power amplifier internal power demand
Supply isolation requirements:	PELV System (DIN 19240)
Input protection	Protected against reverse-polarity
Voltage range:	20 V to 30 V
Allowable voltage ripple:	<2 V_{SS}
Power consumption:	≤ 1.5 A
Stored energy time with power failure (at 24 V) without brake connection	≥ 20 ms

PULSE-C interface

Signal inputs
- Symmetrical — Compatible with RS422-voltage
- Asymmetrical — 4.5V to 30 V
  Connected electrically to 24VGND
- Input resistance — 5 kΩ

Input frequencies:
- Stepping frequency (PULSE/PV, DIR/PR) — ≤ 200 kHz
- Motor current controller (PWM) — 6 kHz to 25 kHz

Step count — 200, 400, 500, 1000, 2000, 4000, 5000, 10000

Signal outputs ($\overline{\text{ACTIVE}}$, $\overline{\text{FUNCT\_OUT}}$) — Open collector outputs short-circuit-proof,
- Output voltage — ≤ 30 V
- Output current, maximum — 50 mA

Speed monitoring (optional)

Signal inputs (A, B) — RS422-level
Connected electrically to 24VGND

- Input frequency — ≤ 400 kHz
  1 600 000 Inc/s
- Encoder pitch — 1000 lines

Output
- Encoder power supply (SENSE) — 5 V ± 5%, ≤ 300 mA
  Sense-controlled
  short-circuit and overload-proof

Brake control

Signal output (ACTIVE_CON) — Short-circuit-proof
- Output voltage — ≤ 30 V
- Output current, maximum — 1.7 A
- Voltage drop at 0.5 A — ≤ 1 V

Reference potential (ACTIVE_0V) — GND of 24 V

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3.2.2 UL 508C certification

The drive TLD01x is certified to UL 508C with the following data.

Line connection

Unit	Line voltage [V]	Line frequency [Hz]	Current [A]	Phases
TLDX11	230 115	47-63	2 4	1
TLDX12	230 115	47-63	5 7.5	1

Motor data

Unit	Motor voltage [V]	Motor frequency [Hz]	Motor current [A]	Phases
TLDX11	0-230	0-2500	3	3
TLDX12	0-230	0-2500	7	3

Accessories

- Holding brake controller, TL HBC
  Power supply 24 V

3.2.3 Accessories

TL HBC holding brake controller

Supply voltage, input	20 V to 30 V
Input current	Input current = 0.5 A + brake current
Output, brake	
DC voltage	20 V to 30 V
Current at 24 V for 100 ms	0.5 A to 2.5 A
Continuous current	0.5 A to 1.25 A
DC voltage with voltage drop	9.5 V to 15 V
Current at 12 V	0.5 A to 2 A

Safe electrical isolation between 24 V input, control input and brake output

Motor cable specification

Motor cables are available from Schneider Electric with the cross-sections indicated. These cables are available in different lengths. Refer to section 9 of this manual for complete cable part numbers. The specifications of the Schneider Electric motor cable are as follows.

Rated voltage:	600 Vac UL and CSA
Construction:	
TLACPVAAxxx1	4x16 AWG/1.5 mm^2
Shield	Braided with 90% coverage
Jacket:	Oil-resistant PUR
Flex Cycles:	Minimum of 1 million cycles/moderate flexing
Temperature rating:	-40 °C to +85 °C (static) -5 °C to +85 °C (flexing)
Minimum bend radius	10 x diameter (static) 10 x diameter (flexing)

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Cable diameters:

TLACPVAAxxx1	0.45 inches (11.3 mm)

Encoder cable specification

Encoder cables of different lengths are available from Schneider Electric. Refer to section 9 of this manual for complete cable part numbers. The specifications of the Schneider Electric encoder cable are as follows:

Rated voltage:	300 Vac UL and CSA
Construction: 10x22 AWG/0.25 mm^2 + 2x20 AWG/0.5 mm^2 conductors	grouped in 6 twisted pair
Shield	Braided with 90% coverage
Jacket:	Oil-resistant PUR
Flex Cycles:	Minimum of 1 million cycles/moderate flexing
Temperature rating:	-40 °C to +85 °C (static) -5 °C to +85 °C (flexing)
Minimum bend radius	10 x diameter (static) 10 x diameter (flexing)
Cable diameters:	0.35 inches (8.8 mm)

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4 Installation

4.1 Electromagnetic compatibility (EMC) and equipment grounding requirements

Strong electromagnetic interference occurs in the power area of the drive. This can influence signals coming from control cables and system parts and jeopardize the operational reliability of the system if suitable protective measures are not taken.

The drive meets the requirements of the EC directives on EMC noise resistance and on noise output as specified in EN-61800-3, as long as the following steps are taken during installation.

⚠WARNING

UNINTENDED EQUIPMENT ACTION

Follow the EMC mitigation methods and procedures shown in the instruction manual to prevent unintended operation or actions by the drive and auxiliary equipment as well as to minimize compliance issues with the EMC directive.

- Always use shielded cable for the motor, control, 24 Vdc, and communications connections to the power amplifier and auxiliary equipment.
- Use the shielded cable assemblies recommended by Schneider Electric.
- Install the shielded cable and terminate the shields as indicated in this section of the instruction manual.
- Use a metallic enclosure and metal mounting plates for the power amplifier and auxiliary equipment.
- Ground and bond the apparatus as described in this section.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Motor leads and encoder cables are especially critical signal circuits. Use only the motor and encoder cables recommended by Schneider Electric. Schneider Electric motor and encoder cables have been tested for EMC stability. In addition, these cables can be used as trailing cables.Refer to "Accessories and spare parts" on page 9-1 for information on cables available from Schneider Electric.

To ensure signal integrity, it is recommended that Schneider Electric communication and data cables be used. Refer to section 9 on page 9-1 for information concerning Schneider Electric data and communication cables.

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Control cabinet setup

EMC measures	Effect
Use zinc or chrome-plated mounting plates. Make large contact surface connections for metal parts. Remove paint from contact surfaces.	Good conductivity due to two-dimensional contacts
Bond the control cabinet, door, and mounting plate by means of metal braid or cables with a diameter greater than 8 AWG (10 mm^2).	Reduction of EMC emissions
Mount power components and control components separately, at a minimum distance 25 cm (9.75 in). Reduce interference injection from either component by using separate mounting panels with individual connection to star-point ground.	Reduction of common coupling path injection
Fit switching devices such as contactors, relays, or solenoids with interference suppressors or spark suppressors (e.g. diodes, varistors, RC elements).	Reduction of radiated and conducted emissions

Cabling

EMC measures	Effect
Keep cables as short as possible. Do not coil excess cable. Keep ground cables short and direct from star-point to outlying ground connection.	Avoidance of capacitive and inductive interference injection
When terminating cable shields, always use cable clamps that make contact with a large surface area around the entire periphery of the shield. For cables passing through the wall of the enclosure, terminate the shield to the closest grounded mounting plate inside the enclosure.	Reduction of EMC emissions
Lay the cables spatially separated from each other: - Signal cables and power cables [>8 in. (20 cm)] - Mains and motor cables [>8 in. (20 cm)] - Mains filter input and output cables	Reduction of mutual interference injection, reduction of emissions, increasing resistance to interference
When splicing cables, connect large surface areas of cable shields. Use cable sleeves and tapes for complete shield coverage of the conductors.	Low shielding effect if the connection is not made over large surface area, reduction of emissions
Ground a large surface area of the shields of the digital signal cables at each end or via Sub-D housing	Avoidance of interference on control cables, reduction of emissions
Ground the shield of the analog signal lines at the power amplifier end only. At the other end, connect a capacitor from ground to the shield, e.g. 10nF/100 V metalized polyester MKT	Avoidance of ground current flow due to power-frequency ground voltage differences
Use only shielded motor cables with copper braiding and at least 85% covering. Ground a large surface area of the shield at each end. Only use motor and encoder cables recommended by Schneider Electric.	Management of interference currents, reduction of emissions
If the motor and machine are not conductively connected (for example use of non-metallic, insulated or irregular mounting surface), bond the motor to the machine with a bonding strap [>6 AWG (10 mm^2)].	Reduction of emissions, increase in resistance to interference

TLADOCD01ME, -002, 12.02

EMC measures	Effect
Ground unused control circuit cable wires at both ends of the cable. Unused motor cables should be insulated at both ends.	Additional shielding effect for control wiring, guarding of stray voltage on unused motor conductors.
For 24 Vdc power supply connections longer than 6.5 feet (2 m), use twisted pair conductor for the 0 V and 24 Vdc supply wires.	Avoidance of noise injection on power supply cables.

Power supplies

EMC measures	Effect
The controller must be operated from a grounded-neutral mains power source. Do not operate the controller from corner-grounded, resistance-grounded, or ungrounded (IT) power sources.	Minimize presence of overvoltage from mains, maintain effectiveness of mains filter, and comply with validated EMC configuration.
The negative bus of the 24 Vdc power source feeding the controller must be bonded to ground.	Comply with validated EMC configuration.
Use twisted pair, shielded conductor for the 24 Vdc power supply connections of the TLD01x drives.	Reduce emissions and comply with validated EMC configuration.

⚠ DANGER

HAZARDOUS VOLTAGE - INADEQUATE GROUNDING

- The power amplifier and auxiliary equipment must be grounded before applying power. Refer to Fig. 4.1 and sections 4.4 and 4.5 of this manual for information concerning the proper grounding of Twin Line product.
- The cross-sections of the grounding conductors used to ground the individual power amplifiers and auxiliary equipment should comply with applicable codes.
- Do not use metallic conduits as a ground conductor. Use a conductor housed within the conduit as the ground conductor. The grounding conductor cross-section should comply with applicable installation codes.
- When cable shields are used as ground conductors, the shield must have a cross-section no smaller than the power conductors housed within the shield. If the shield does not have sufficient cross-section, then a separate power conductor housed within the shield and of sufficient cross-section must be used as the grounding conductor. The shield should be terminated to the grounding conductor at both ends of the shielded cable assembly.

Failure to follow this instruction can result in death, serious injury or equipment damage.

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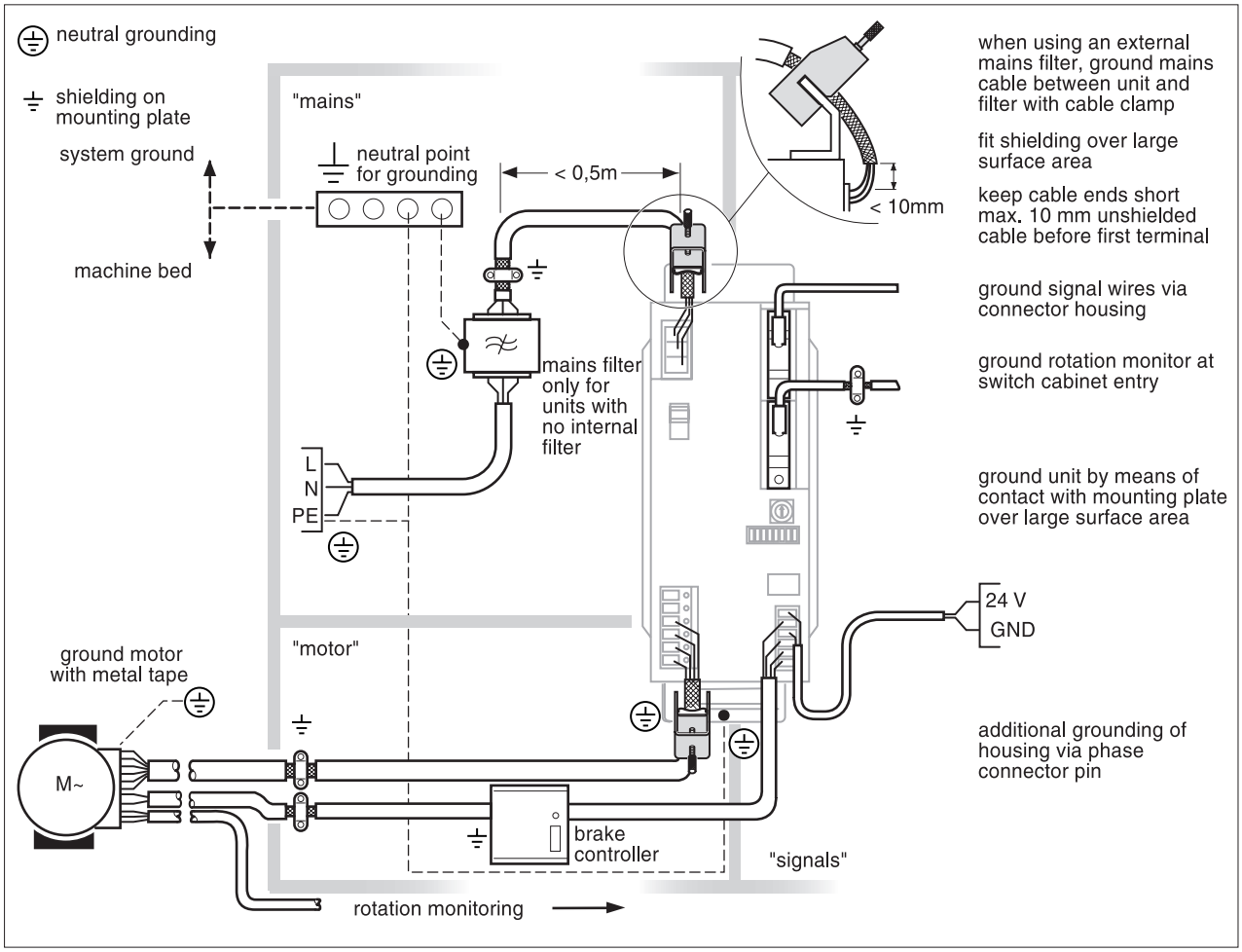

Fig. 4.1 EMC measures

TLADOCD01ME, -002, 12.02

4.2 System components

Besides the components included in the scope of delivery, other system components are required for connecting the drive:

- Three-phase stepper motor
- Motor cable
- Signal cable
- Encoder cable when unit fitted with speed monitoring
- Line cable and line fuses
- External power supply, 24 V_{DC} with safe separation - PELV
- External line filter for units with no built-in line filter
- Control cabinet
- Additional filters and chokes for line connection and motor connection, depending on system configuration
- NC control or PLC for automatic operation

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4.3 Mechanical installation

⚠CAUTION

EQUIPMENT DAMAGE HAZARD

- Do not install or operate any equipment that appears damaged.
- Block debris (such as wire strands, metal turnings, or filings) from entering into the equipment during unpacking and installation. Do not operate equipment that may contain debris.
- If fastening hardware falls into the equipment, locate and remove the lost pieces before applying power.

Failure to follow this instruction can result in death, serious injury or equipment damage.

Before installation...

▶ Check the drive for outwardly visible damage such as dents in the housing or broken connection terminals. Do not install damaged drives or auxiliary equipment.

4.3.1 Mounting the TLD01x drive

Control cabinet

The control cabinet must be big enough to allow both unit and accessories such as ballast resistor controller and holding brake controller to be firmly mounted and connected in line with EMC requirements.

It must be possible to extract the heat generated by the unit and components during operation through the switch cabinet vents.

Installation clearances

The unit is fitted with a built-in fan. Ventilation slots on and under the unit must be kept at least 70 mm (2.74 in.) away from neighboring units or walls.

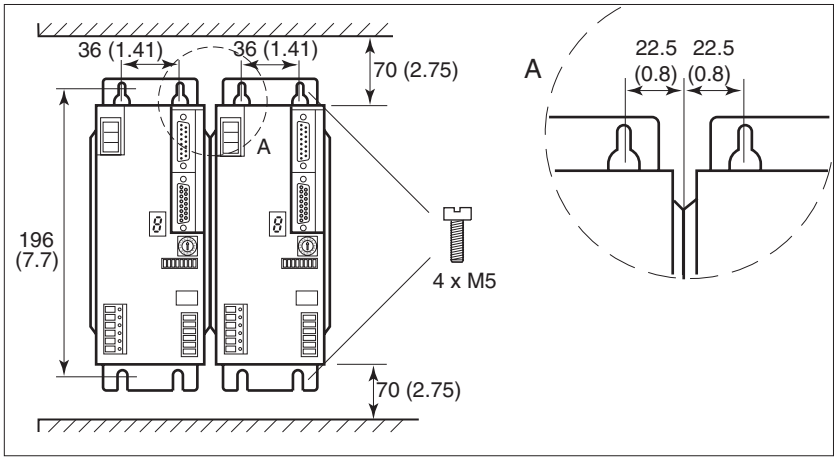

Fig. 4.2 Installation clearances, dimensions in mm (in.)

TLADOCD01ME, -002, 12.02

- ▶ Position the unit in the control cabinet such that the heated air flow from other units, for example from an external ballast resistor, does not result in undesired heating of the cooling air.
- ▶ Mount the unit vertically with the power connection at the top.
- ▶ Fasten the unit to a galvanized metal plate. The back wall of the unit must have good contact with the metal plate across its whole surface area.

Painted surfaces have an insulating effect. Before fixing the unit to a painted mounting plate, scratch off the paint over a wide surface area in the places where the unit is to be mounted, to ensure that it has a good connection with the grounded plate.

4.3.2 Fitting the drive label

The drive label provides information on the meaning of all operating states displayed on the 7-segment display, and on signal interface assignment. An example of the unit label for copying is provided in section "Drive label", page 10-1.

- ▶ Attach the unit label inside the hood of the Twin Line unit on the side where the signal plugs are connected.

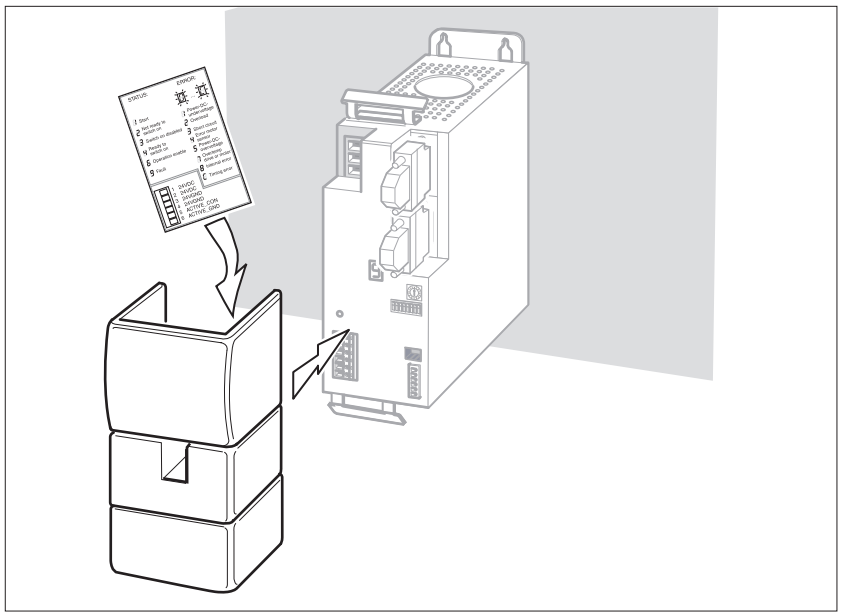

Fig. 4.3 Attach device label to the side of the hood

After the electrical installation has been completed and the unit hood installed, the cables for connection to power and the cables for both upper signal connections are led out through the top of the hood, while the motor cable and other signal cables are taken out through the bottom.

4.3.3 Installing accessories on the drive

Mains filter

The drive is supplied with a mains filter built in the standard design. A special version of the unit can also be ordered without a mains filter.

Do not use the units with external mains filters unless you can make test measurements at the unit of the functioning and the EMC of a selected mains filter.

An external mains filter is required for a standard unit without a built-in mains filter. The user must ensure that the EMC directives are observed in this case.

The type plate on the front of the unit states whether a mains filter is built in or not:

- "F": with mains filter, e.g. TLD01x F
- "D": without mains filter, e.g. TLD01x D

Select a two-stage mains filter, e.g. for a frequency converter. The size and selection of a suitable filter is for the system designer to decide.

▶ Fit the mains filter near the mains connection and on the same mounting plate. The length of the cable to the drive must not exceed 50 cm. **The cable must be shielded and the shield must be grounded at both ends.**

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4.4 Electrical installation

⚠ DANGER

HAZARDOUS VOLTAGE

Before installing, adjusting, repairing or maintaining the Twin Line drive or its accessories:

- Read and understand the procedures in this section of the instruction manual.
- Read and understand section 2, *Safety*, of this instruction manual.
- Read and understand the grounding requirements found in section 4.1, *Electromagnetic compatibility, EMC,* of this instruction manual.
- Obey the safety-related work practices found in NFPA 70E, *Standard for Electrical Safety Requirements for Employee Workplaces*.

Installation, adjustment, repair, and maintenance of the Twin Line drive or its accessories must be performed by qualified personnel.

Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠ WARNING

UNINTENDED EQUIPMENT ACTION / LOSS OF CONTROL

- Follow the EMC mitigation methods and procedures shown section 4.1 of this instruction manual to prevent unintended operation by the drive controller and auxiliary equipment.
- To maintain the ElectroMagnetic Compatibility (EMC) of the overall system, any electrical apparatus mounted adjacent to or interconnected with the Twin Line drive must not generate electrical emissions that interfere with the expected operation of the Twin Line drive nor be detrimentally affected by emissions from the Twin Line drive.
- The designer of any control scheme must consider the potential failure modes of the control signal paths and, for certain critical control functions, provide a means to achieve a safe state during and after a signal path failure. Examples of critical control functions are Emergency Stop and Overtravel Stop. Refer to NEMA ICS1.1 *Safety Guidelines for the Application, Installation and Maintenance of Solid State Control* and NEMA ICS7.1 *Safety Standards for construction and Guide for Selection, Installation and Operation of Adjustable –Speed Drive Systems* for further information.
- System control signal paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failure of the link.

Failure to follow these instructions can result in death, serious injury or equipment damage.

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4.4.1 Mains connection

⚠WARNING

OVERCURRENT PROTECTIVE DEVICES MUST BE PROPERLY COORDINATED

- To achieve published fault withstand current ratings, install the specified fuses listed in section 3.2.1 of this instruction manual.
- Do not connect the drive to a power feeder whose short circuit capacity exceeds the short circuit rating listed in section 3.2.1 of this instruction manual!

Failure to follow these instructions can result in death, serious injury or equipment damage.

CAUTION

EQUIPMENT DAMAGE HAZARD

Drives with single-phase inputs must be connected to the same mains phases if the drive DC busses are paralleled. For systems where the drive power inputs are connected to neutral, the interconnection of the DC busses of two drives connected to different phases will result in overvoltage that can destroy the drives.

Failure to follow these instructions can result in death, serious injury or equipment damage.

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Connect power cable

▶ Connect power lines to PE, N and L screw terminals

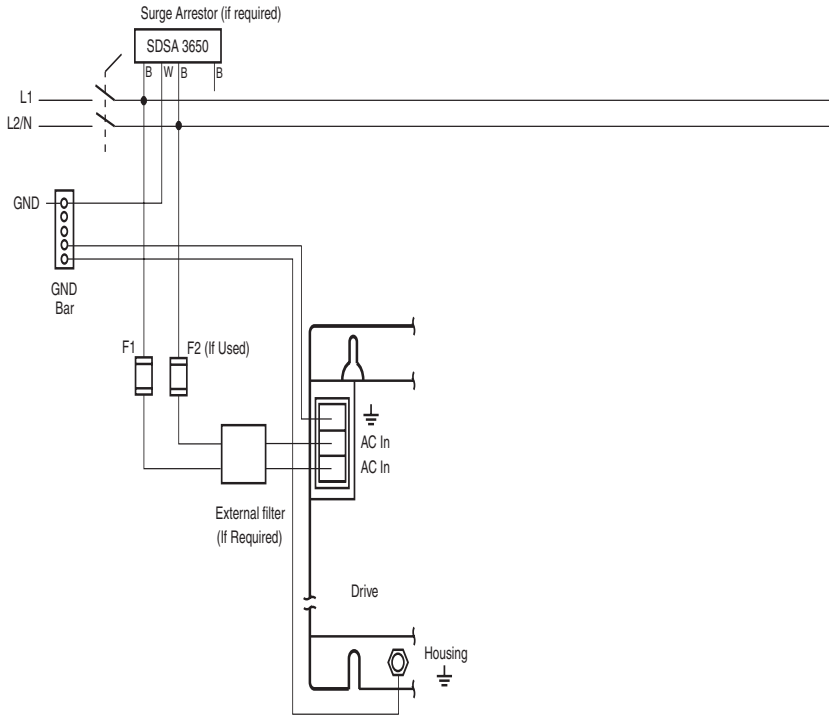

Fig. 4.4 Mains connection

- The connection cross-section for power cables is 1.5 mm^2 (16 AWG) to 2.5 mm^2 (14 AWG).
- Fit a fuse in the power phase:
  at 230 V terminal: 10 A (Class CC)
  at 115 V terminal: 10 A (Class CC)
- In the case of units without integrated mains filter, D types, the power cable must be shielded and grounded at both ends between the filter and the unit terminal if it is longer than 20 cm (7.87 in.).
- The correct torque for the terminal screws is 0.4 Nm - 0.5 Nm.
- The individual conductors of the cable can be connected to the unit without wire end ferrules.
- For units with a hood, the cable must be led upwards from the point of connection.

Wire end ferrules

If you use wire end ferrules, pay attention to the following:

- Do not use end ferrules with a plastic collar on wires with a cable cross-section of 2.5 mm^2 (14 AWG).
- Only use square end ferrules to ensure that they do not work loose.
- Strip the insulation from the cable to a length of 10 mm (3.94 in.).

Ground leakage circuit-breaker

If a fault occurs, fault currents with DC component may occur. For single-phase units, an e.l.c.b. for fault currents with a pulsating DC component can be fitted.

4.4.2 Motor connection to the drive

⚠ DANGER

HAZARDOUS VOLTAGE – STEPPER-GENERATED AND COUPLED VOLTAGE

- The stepper can produce voltage at its terminals when the shaft is rotated! Prior to installation or servicing, block the stepper shaft to prevent rotation.
- DO NOT contact the motor terminals or circuits connected to the motor terminals when the motor shaft is turned!
- AC voltage from the drive or stepper can couple voltage to unused conductors in the motor cable. Insulate both ends of unused conductors in the motor cable.

Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠ DANGER

HAZARDOUS VOLTAGE – INADEQUATE GROUNDING

When cable shields are used as ground conductors, the shield must have a cross section no smaller than the power conductors housed within the shield. If the shield does not have a sufficient cross section, then a separate power conductor housed within the shield and of sufficient cross section must be used as the grounding conductor. The shield should be terminated to the grounding conductor at both ends of the shielded cable assembly.

Failure to follow this instruction can result in death, serious injury or equipment damage.

Connecting motor wires

▶ Connect the motor wires and protective ground to terminals U, V, W and PE. Wiring assignment for motor and unit must match.

Terminal	Connection	Color
U	Motor cable	brown (bn)
V	Motor cable	blue (bl)
W	Motor cable	black (bk)
PE	Protective conductor (shield tracer wire)	-

TLADOCD01ME, -002, 12.02

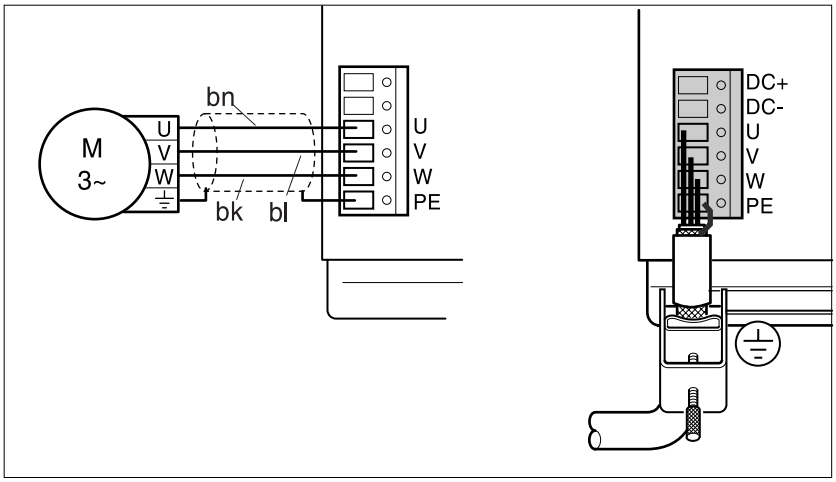

Fig. 4.5 Motor cable connection to unit

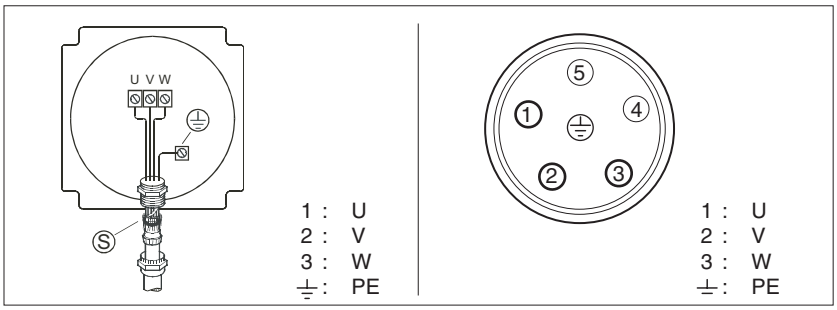

Fig. 4.6 Motor cable connected to motor with terminal box or plug

Cable connection to the drive terminal

- Cable cross-section: 1.5 mm^2 (16 AWG)
- Maximum cable length: 20 m (787.4 in.)
- The correct torque for the terminal screws is 0.4 Nm - 0.5 Nm.
- The individual conductors of the cable can be connected without wire end ferrules.

Preparing the motor cable on the drive side

- For units with a hood, the cable must be led downwards from the point of connection.

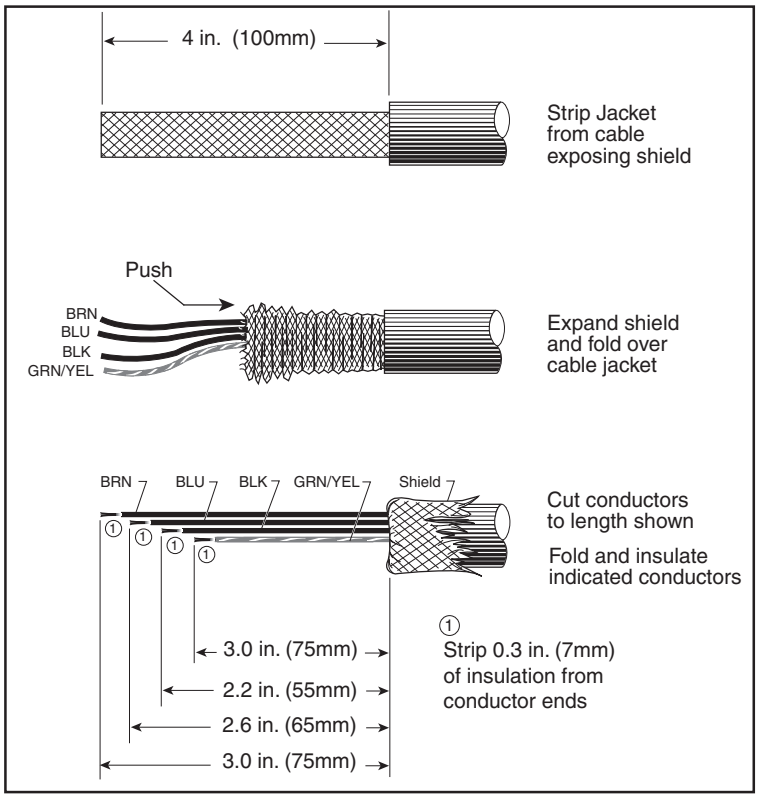

Fig. 4.7 Preparing the motor cable

Wire end ferrules

If wire end ferrules are used, pay attention to the following:

- Only use square end ferrules to ensure that they do not work loose.
- The wire must fill the wire end ferrule over its whole length. Only then has the connection been safely carried out, ensuring maximum current carrying capacity and vibration resistance.

EMC measures

The motor cable is a source of interference and must be carefully laid:

- The shield braiding of the motor cable must be connected to the motor housing and to the unit housing as well as to the switch cabinet entry with a large surface area connection. Use the supplied shielded terminal for the connection to the housing.
- Where possible motor cables and signal wiring must laid at least 20 cm apart; if they are laid closer together, motor cables and signal wiring must be shielded with grounded plates.

TLADOCD01ME, -002, 12.02

4.4.3 Cable gland connection to the motor terminal box

⚠ DANGER

HAZARDOUS VOLTAGE – STEPPER-GENERATED AND COUPLED VOLTAGE

- The stepper can produce voltage at its terminals when the shaft is rotated! Prior to installation or servicing, block the stepper shaft to prevent rotation.
- DO NOT contact the motor terminals or circuits connected to the motor terminals when the motor shaft is turned!
- AC voltage from the drive or stepper can couple voltage to unused conductors in the motor cable. Insulate both ends of unused conductors in the motor cable.

Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠ DANGER

HAZARDOUS VOLTAGE – INADEQUATE GROUNDING

When cable shields are used as ground conductors, the shield must have a cross section no smaller than the power conductors housed within the shield. If the shield does not have a sufficient cross section, then a separate power conductor housed within the shield and of sufficient cross section must be used as the grounding conductor. The shield should be terminated to the grounding conductor at both ends of the shielded cable assembly.

Failure to follow this instruction can result in death, serious injury or equipment damage.

When connecting a stepper motor with a terminal box use a motor cable with the following specification:

Stepper motor cable specification

- 1 Lead PE green/yellow 1.5 mm^2 (16 AWG)
- 3 Leads for the motor connection 1.5 mm^2 (16 AWG) (Leads colored or black with printing)
- Lead insulation: PP/PE or TPM (low capacity < 70 pF/m)
- Overall shield, coverage min. 90%
- Cable - diameter: 8.5 - 11.5 mm

Cable gland specification

Motor Size	Cable gland type	Cable diameter
VRDM 36x	PG 13.5 or M 20x1.5mm	6mm to 12mm
VRDM 39x	PG 16 or M 20x1.5mm	9mm to 13mm
VRDM 3Bx	PG 16 or M 20x1.5mm	9mm to 13mm

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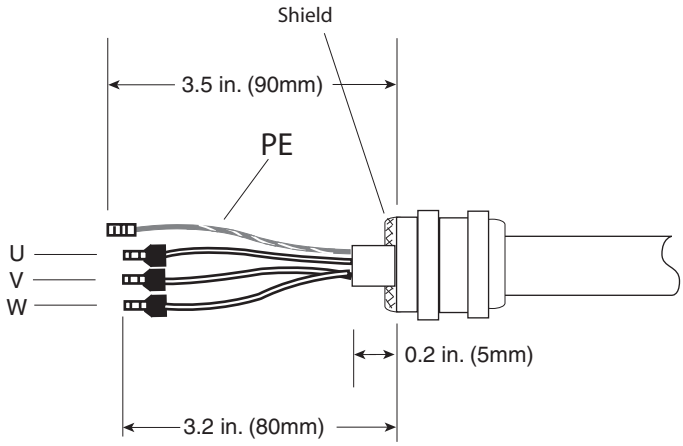

Fig. 4.8 Preparing the cable gland

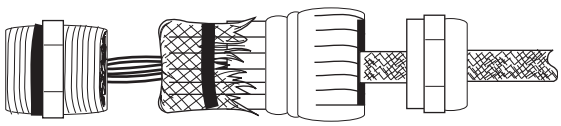

Fig. 4.9 Mounting the cable gland

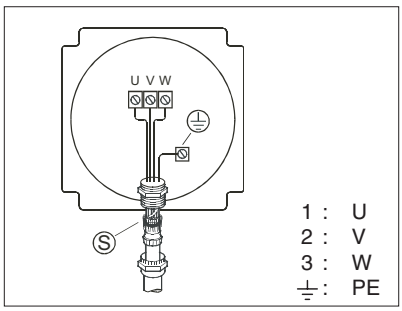

Fig. 4.10 Wiring inside the motor

TLADOCD01ME, -002, 12.02

4.4.4 Connecting the 24 V supply voltage

⚠WARNING

UNINTENDED EQUIPMENT ACTION

The Twin Line drive and certain auxiliary equipment require the use of an external 24 Vdc power supply. Improper selection or installation of the power supply can result in unintended equipment action due to electromagnetic interference or inadvertent grounds of the control wiring.

- Use a power supply suitable for Protective Extra Low Voltage (PELV) operation.
- Bond the negative power output terminal of the power supply to the enclosure ground bar. Refer to NFPA 79 *Electrical Standard for Industrial Machinery* and EN60204-1 *Electrical equipment of machines, General requirements* for control circuit grounding practices.
- Do not connect any protective device (i.e. fuses) or switch between the negative output of the 24 V power supply and any connected load.
- For 24 Vdc power supply connections longer than 6.5 ft. (2 m), use twisted pair conductor for the 0 V and 24 Vdc supply wires.

Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠CAUTION

CONTACT WELDING AND DAMAGE

The Twin Line drive 24 Vdc input (pins 1 and 2) is not equipped with inrush current limitation. If power is fed via a switching contact to the 24 Vdc input, contact welding or damage may result during power-up if the 24 Vdc power source has no transient output current limitation (i.e. transformer-rectifier-capacitor power supply). Contact damage can be mitigated in the following ways.

- Use a power supply that will limit the transient output current to a value less than the damage level of the contact.
- If the power supply transient output current is unknown or greater than permissible for the contact and switching of the 24 Vdc power supply is required, switch the mains input connection to the power supply instead of the output.

Failure to follow this instruction can result in death, serious injury or equipment damage.

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▶ Route the 24 V wires to the unit over a grounded 24 V_{DC} transformer (PELV).

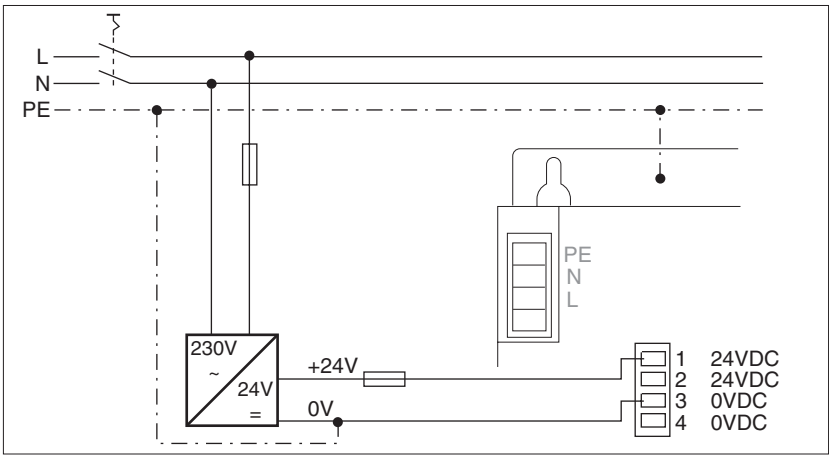

Fig. 4.11 24 V connection

Pin	Signal	Active	Meaning	I/O
1	24VDC	-	24 VDC supply voltage, internally connected to pin 2	-
2	24VDC	-	24 VDC power supply	-
3	0VDC	-	GND for 24 VDC voltage, internally connected with pin 4 and pin 6 (ACTIVE_0V)	-
4	0VDC	-	GND for 24 VDC voltage	-

- The second 24 VDC and GND connection can be used as a 24 V output for further consumers or for cascading several Twin Line units; the maximum terminal current is 7.5 A.
- In selecting your 24 V power supply unit make sure you take into account any additional consumers, such as the holding brake and the holding brake controller.
- To retain the position of the motor when the supply voltage to the power amplifier is switched off, the ENABLE input signal must be set to Low before the supply voltage is shut off. The external 24 V supply voltage must remain switched on, and the motor must not be subjected to external torque.
- Lay the 24 V supply line at a distance of at least 20 cm from other lines to ensure EMC protection. For wiring longer than 2 m, make a twisted pair of the 0 V and 24 V supply wires.
- The torque for terminal screws 1-34 is 0.22 Nm to 0.25 Nm.

TLADOCD01ME, -002, 12.02

4.4.5 Connecting a holding brake

⚠ DANGER

HAZARDOUS VOLTAGE – STEPPER-GENERATED AND COUPLED VOLTAGE

- The stepper can produce voltage at its terminals when the shaft is rotated! Prior to installation or servicing, block the stepper shaft to prevent rotation.
- DO NOT contact the motor terminals or circuits connected to the motor terminals when the motor shaft is turned!
- AC voltage from the controller or stepper can couple voltage to unused conductors in the motor cable. Insulate both ends of unused conductors in the motor cable.

Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠ DANGER

HAZARDOUS VOLTAGE – INADEQUATE GROUNDING

When cable shields are used as ground conductors, the shield must have a cross section no smaller than the power conductors housed within the shield. If the shield does not have a sufficient cross section, then a separate power conductor housed within the shield and of sufficient cross section must be used as the grounding conductor. The shield should be terminated to the grounding conductor at both ends of the shielded cable assembly.

Failure to follow this instruction can result in death, serious injury or equipment damage.

In motors with holding brakes the brake can be connected directly or to the signal interface via the TL HBC holding brake controller. The holding brake controller connection is described in "Connecting accessories" on page 4-30.

Use the following circuit with direct control to protect the motor from overheating. The circuit reduces the exciter current shortly after the brake is opened.

The values for R1 and C1 are given for the manufacturer's VRDM 39... and VRDM3B.. motors.

Motor	VRDM 36...	VRDM 39...	VRDM 3B...
Resistance R1	72 Ω, min. 4 W	24 Ω, min. 6 W	18 Ω, min. 8 W
Capacitor C1	4700 µF / 25 V	4700 µF / 25 V	6800 µF / 25 V

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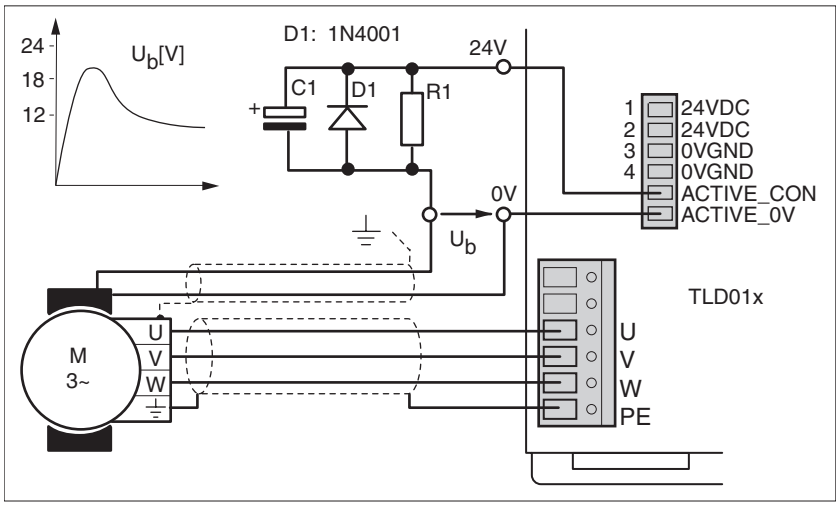

Fig. 4.12 Holding brake controller connection

For more information see section "Connecting accessories" at page 4-30.

The static load torque for vertical loads must not exceed 25% of the motor holding torque to ensure safe function of the holding brake.

Only use cables with the following specifications:

	TLD011	**TLD012**
Cable cross-section	1.5 mm^2 (16 AWG)	1.5 mm^2 (16 AWG)
Max. cable length [1)]	20 m (984 in.)	20 m (984 in.)

1) Longer cables on request

4.4.6 Connection to the PULSE-C interface

Connection The PULSE-C interface is equipped with a Sub-D plug, 15-pin with an M3 threaded connection.

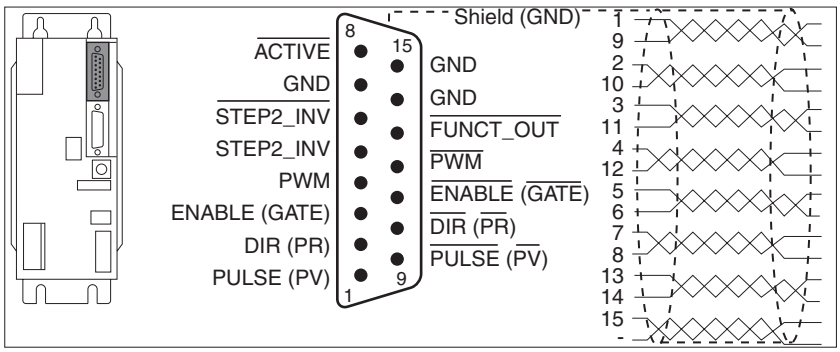

Fig. 4.13 PULSE-C interface

Pin	Signal	Color [1]	Pair	Meaning	I/O
1	PULSE (PV)	white	1	Motor step "Pulse" or motor step forwards "PV"	I
9	$\overline{\text{PULSE (PV)}}$	brown	1	Motor step "Pulse" or motor step forwards "PV", inverted	I
2	DIR (PR)	green	2	Direction of rotation "Dir" or motor step backwards "PR"	I
10	$\overline{\text{DIR (PR)}}$	yellow	2	Direction of rotation "Dir" or motor step backwards "PR", inverted	I
3	ENABLE (GATE)	gray	3	Enable signal	I
11	$\overline{\text{ENABLE (GATE)}}$	pink	3	Enable signal, inverted	I
4	PWM	blue	4	Phase current value	I
12	$\overline{\text{PWM}}$	red	4	Phase current value, inverted	I
5	STEP2_INV	black	5	Angular resolution transfer	I
6	$\overline{\text{STEP2\_INV}}$	purple	5	Angular resolution transfer, inverted	I
7	GND	pink/pink	6	Ground, signal applied internally via resistance at 24VGND	-
8	$\overline{\text{ACTIVE}}$	red/blue	6	Drive ready	O
13	$\overline{\text{FUNCT\_OUT}}$	white/green	7	Following error message	O
14	GND	brown/green	7	Ground, signal applied internally via resistance at 24VGND	-
15	GND	white/yellow	8	Ground, signal applied internally via resistance at 24VGND	-

1) Color details refer to the cable available as an accessory.

Cable specification

- shielded cable
- minimum cross-section of signal wires 0.14 mm^2 (25 AWG)
- twisted-pair wires
- shield grounded at both ends
- maximum length:
  100 m (3937 in.) with RS422 connection
  up to 10 m (393.7 in.) with Open Collector connection

Function

Setpoint via externally fed pulse-direction signals

Reference signals for step-by-step positioning of the motor and control signals for motor current, angular resolution and power amplifier release are sent over the PULSE-C interface. The drive simultaneously reports that it is ready for operation and possible operating fault over the interface.

PULSE (PV), DIR (PR)

The square-wave signals PULSE (PV) and DIR (PR) can be combined for two operating modes. The setting of DIP switch 6 sets the operating mode:

- PULSE/DIR: Pulse-direction signal with DIP 6 ON
- PV/PR: $Pulse_{forward}$ - $Pulse_{backward}$ signal with DIP 6 OFF

PV/PR signals can only be used with units with speed monitoring.

Information on the DIP switches can be found in the section "Set DIP switch" on page 5-6.

Pulse direction mode

The motor executes an angular step with the leading edge of the PULSE signal. The direction of rotation is controlled by the DIR signal.

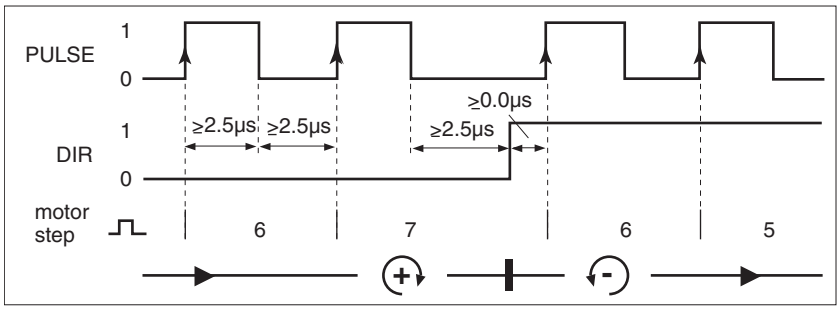

Fig. 4.14 Pulse direction signal

Pin	Signal	Function	Value
1, 9	PULSE	Motor step	low -> high
2, 10	DIR	Clockwise direction of rotation Counter-clockwise direction of rotation	low/open high

Operating mode Pulse$_{forward}$ - pulse$_{backward}$

The PV (PULSE) signal is used to move the motor in a clockwise direction, and the PR (DIR) signal moves it in an counter-clockwise direction.

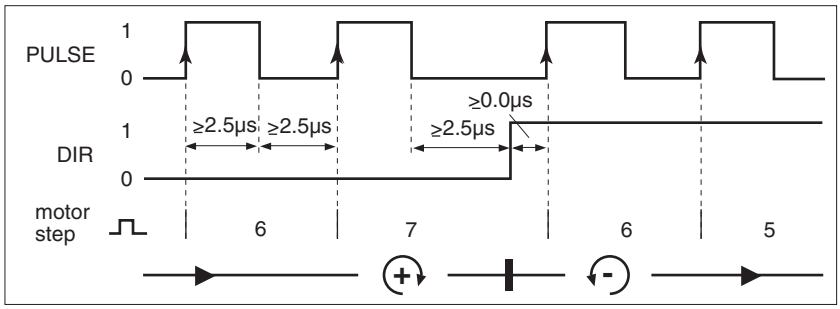

Fig. 4.15 Pulse$_{forward}$ - Pulse$_{backward}$ signal

Pin	Signal	Function	Value
1, 9	PULSE (PV)	PV: Step in clockwise direction of rotation	low -> high
2, 10	DIR (PR)	PR: Step in counter-clockwise direction of rotation	low -> high

The maximum frequency of PULSE (PV) and DIR (PR) is 200 kHz.

ENABLE (GATE)

The ENABLE (GATE) input has two functions, which are set with DIP switch 5:

- ENABLE function: enable and disable power amplifier, DIP 5 = OFF
- GATE function: enable and disable pulse input, DIP 5 = ON

Information on the DIP switches can be found in the section "Set DIP switch" on page 5-6.

ENABLE function

The ENABLE (GATE) signal enables the power amplifier so the motor can be controlled. This requires DIP switch 5 to be set to OFF.

Pin	Signal	Function	Value
3, 11	ENABLE	Disable power amplifier Enable power amplifier	low/open high

An error message is also acknowledged with a negative slope at the ENABLE input.

If there is no operating fault, the $\overline{\text{ACTIVE}}$ output displays operational readiness for approx 100 ms after the power amplifier is enabled. Then pulses can be fed in for units without speed monitoring and brake.

Units with brake or speed monitoring require waiting periods before feeding in pulses to release a holding brake or to initialize the encoder.

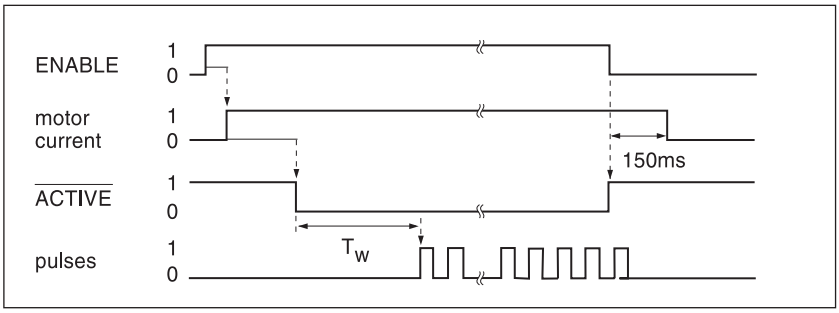

Fig. 4.16 Enabling and blocking the power amplifier with waiting time T_W

Twin Line unit…	without brake	with brake
without speed monitoring	T_W= 0 ms	T_W= 100 ms
with speed monitoring	T_W= 300 ms	T_W= 300 ms

If the ENABLE signal is removed, the power amplifier remains active for 150 ms to allow a holding brake to close. If an error that results in the power amplifier shutting down, the motor current is simultaneously shut off with $\overline{\text{ACTIVE}}$.

See page 5-8 for a view of the ENABLE function in motor operation.

GATE function

The GATE signal blocks the pulses at the setpoint value input with stopping it from being ready to operate. The GATE function can be used to select individual axes in a multi-axis system. DIP switch 5 must be set to ON for the GATE function.

Pin	Signal	Function	Value
3, 11	ENABLE (GATE)	Enable power amplifier Disable power amplifier	low/open high

The following graph shows the motor movement when the GATE function is enabled. There must be no pulse pending for 1.5 ms before and after switching the GATE signal.

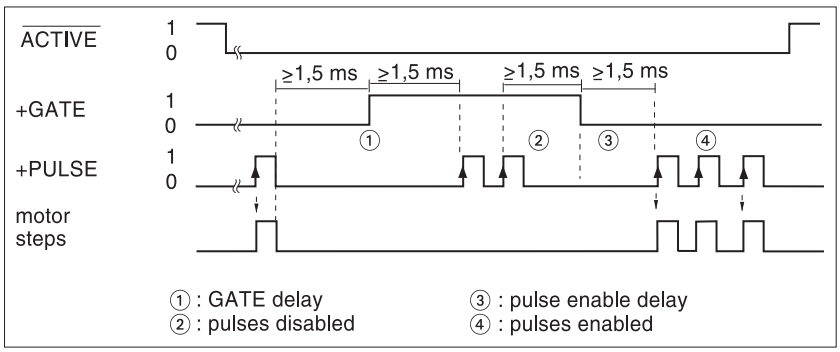

Fig. 4.17 Signal sequence when switching on the unit with GATE function

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STEP2_INV The resolution of the motor step count can be increased by a factor if ten if this function is enabled by DIP switch 1 and has been activated with the signal STEP2_INV. STEP2_INV reverses the DIP switch setting.

Pin	Signal	Function	Value
5, 6	STEP2_INV	Angular resolution - as set with DIP 1 - DIP 1 setting inverted	 low/open high

The following graph shows the motor movement with the STEP2_INV signal enabled. There must be no pulse pending for 1.5 ms before and after switching the STEP2_INV signal.

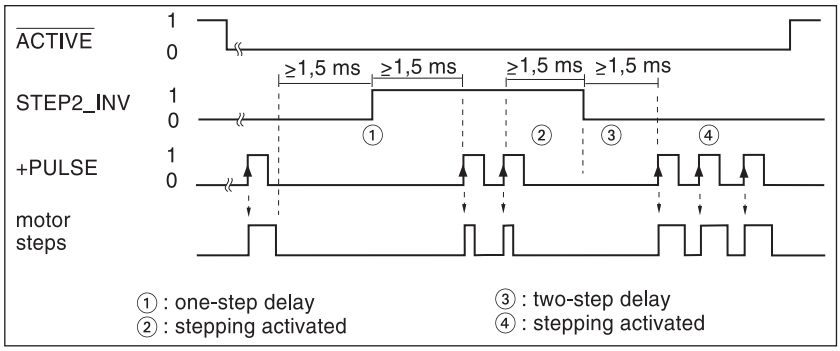

Fig. 4.18 Signal sequences when switching the step number

PWM The preset motor phase current and therefore the motor torque can be reduced to between 0% and 100% with the pulse-width-modulated signal.

Pin	Signal	Function	Value
4, 12	PWM	maximum motor phase current reduced motor phase current	low/open high

If there is constant high level at the PWM input, phase current does not flow and the motor has no current. If there is constant low level the motor operates at the set maximum phase current.

Only set the PWM controller together with the ENABLE function, not with the GATE function. The motor receives the full motor current with the GATE function if the PWM controller is switched off or fails.

$\overline{\text{ACTIVE}}$ The output shows that the drive is ready for operation.

Pin	Signal	Function	Value
8	$\overline{\text{ACTIVE}}$	power amplifier is disabled power amplifier is enabled	high low

$\overline{\text{ACTIVE}}$ is an open collector output to GND.

$\overline{FUNCT\_OUT}$ The output signals a following error if an encoder is connected and the encoder monitoring is enabled.

Pin	Signal	Function	Value
13	$\overline{FUNCT\_OUT}$	standard operating status following error message	low high

If $\overline{FUNCT\_OUT}$ signals a following error, the signal must be reset before continuing to operate. You will find information in "Error display and rectification" on page 7-2.

$\overline{FUNCT\_OUT}$ is an open collector output to GND.

Circuit of the signal inputs

⚠WARNING

UNINTENDED EQUIPMENT ACTION / LOSS OF CONTROL

Operation of the PULSE-C module differential inputs using single-ended outputs can reduce the electrical noise immunity of the signal transmission.

- Driving the PULSE-C module inputs with single-ended outputs is not recommended if PULSE-C input signal integrity is critical to the motion system operation.
- Single-ended outputs are not recommended as the drive for the differential inputs of the PULSE-C module if the motion equipment is being installed in an electro magnetically noisy environment.
- If single-ended outputs are used to drive the PULSE-C module inputs, limit the maximum cable length to less than 33 feet (10m) and limit the maximum operating frequency to less than 50kHz.
- Use shielded twisted-pair cable to connect the PULSE-C module.

Failure to follow these instructions can result in death, serious injury or equipment damage.

It is recommended that signal inputs be switched via the RS422 interface.

The diagram shows the circuitry of the signal inputs PULSE (PV), DIR (PR) and ENABLE. Up to 10 inputs of the PULSE-C module can be connected to an RS422-C transmitter.

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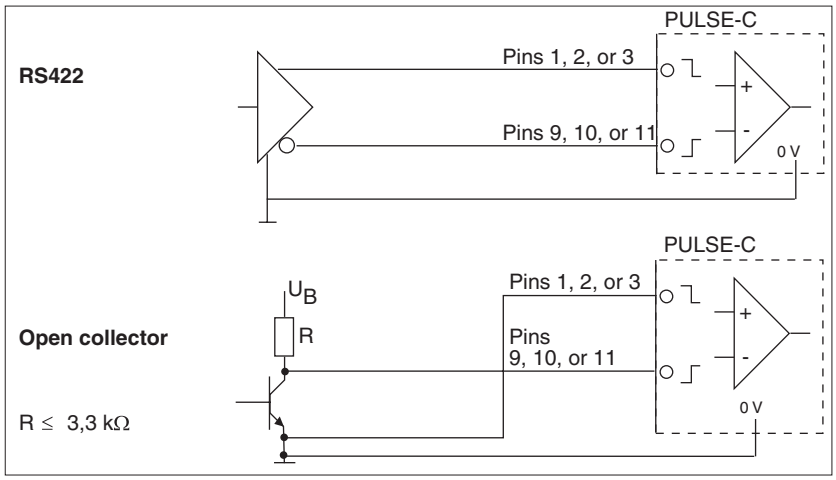

Fig. 4.19 Circuit of the signal inputs, L: Cable length

For cable lengths ≤10 m and frequencies ≤50 kHz, Open Collector outputs can be used if interference resistance requirements are low.

4.4.7 Connection to the interface for speed monitoring

The optional encoder interface is only built-in in units with speed monitoring.

Connection The interface is equipped with a Sub-D socket, 15-pin with an M3 threaded connection.

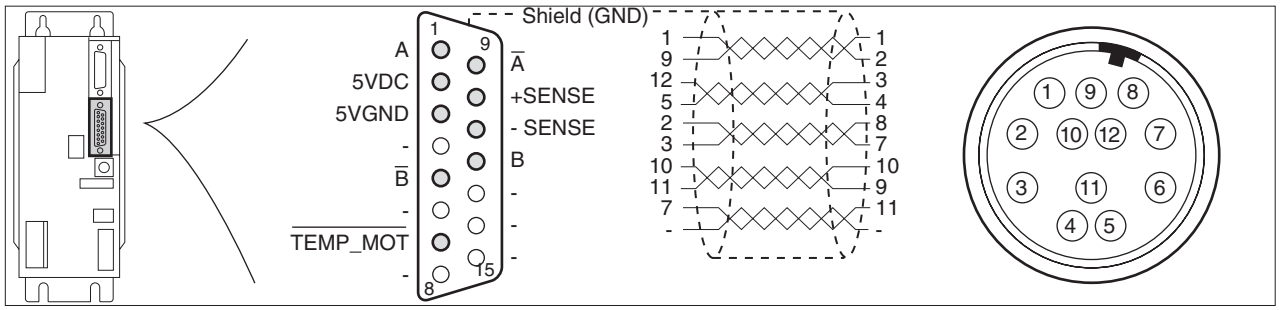

Fig. 4.20 Interface for speed monitoring, motor plug view: solder side

Pin	Signal	Color [1]	Pair	Meaning	I/O
1	A	white	1	Encoder signal channel A	I
9	$\overline{A}$	brown	1	Channel A, negated	I
12	B	green	2	Channel B	I
5	$\overline{B}$	yellow	2	Channel B, negated	I
2	5VDC	red	3	Encoder supply, 5V, max. 300mA	O
3	5VGND	blue	3	Encoder supply, ground	O
10	+SENSE	purple	4	Sense line positive [2]	I
11	-SENSE	black	4	Sense line negative[2]	I
7	$\overline{TEMP\_MOT}$	grey/pink	6	Temperature error, inverted	I
4	-	red/blue	6	not assigned	-
6	-	-	5	not assigned	-
8	-	-	5	not assigned	-
13	-	-	-	not assigned	-
14	-	-	-	not assigned	-
15	-	-	-	not assigned	-

1) Color details refer to the cable available as an accessory.
2) Sense line must be connected for activating the 5VDC.

Cable specification

- shielded cable
- minimum cross-section of the signal conductors is 0.25 mm^2 (22 AWG), 5VDC and 5VGND 0.5 mm^2 (20 AWG)
- twisted-pair wires
- shield grounded at both ends
- maximum length 100 m (3937 in.)

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Function

The angular position of the motor is transferred incrementally over the connection with A/B rectangular signals. The unit detects stepper errors by comparison with the setpoint position and reports a following error if the limit value of 6.4° is exceeded.

The drive does not evaluate index pulses.

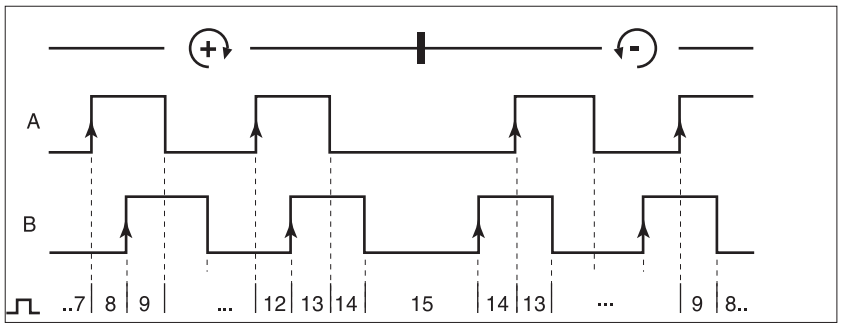

Fig. 4.21 Timing diagram with positive A and B signal, counting forwards and backwards

Temperature monitoring

The motor winding temperature is monitored with the TEMP-MOT signal. The signal also indicates whether the encoder is connected.

Pin	Signal	Function	Value
7	$\overline{\text{TEMP\_MOT}}$	Temperature range OK Overheating of motor or break in cable	high low

Encoder type

An encoder with 1000 lines must be connected to use the speed monitoring.

4.4.8 Connecting accessories

⚠ DANGER

HAZARDOUS VOLTAGE – INADEQUATE GROUNDING

When cable shields are used as ground conductors, the shield must have a cross-section no smaller than the power conductors housed within the shield. If the shield does not have sufficient cross-section, then a separate power conductor housed within the shield and of sufficient cross-section must be used as the grounding conductor. The shield should be terminated to the grounding conductor at both ends of the shielded cable assembly.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Holding brake controller

In motors with holding brakes the brake can be connected directly or via the TL HBC holding brake controller.

The ACTIVE-CON control signal is amplified with the holding brake controller to ensure that the brake switches quickly and generates as little heat as possible.

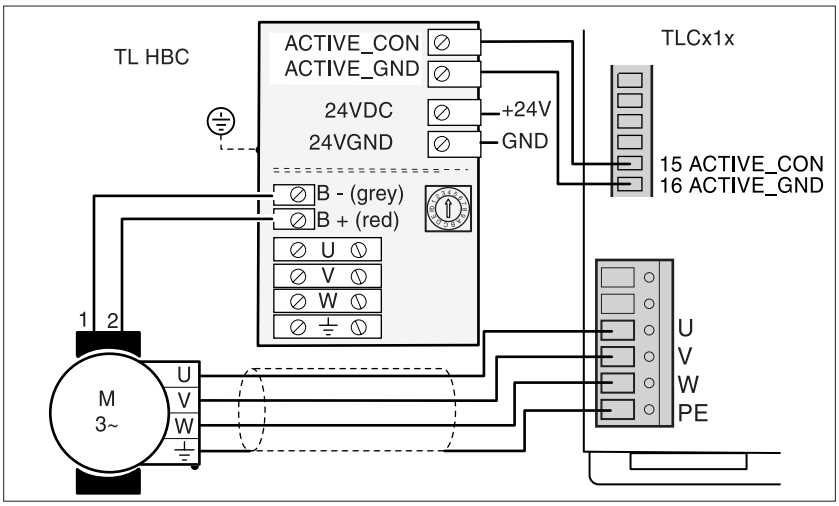

Fig. 4.22 Connection of the TL HBC holding brake controller

Connection

The connection of the motor cable is described on page 4-12.

- ▶ Connect the control connections to the holding brake terminals B+ and B-.
- ▶ Connect the control terminals ACTIVE_CON and ACTIVE_0V of the brake controller and the signal interface.
- ▶ Connect the 24 V_{DC} power supply to the holding brake controller.

The holding brake controller's power requirement depends on the switching current for the holding brake:

Brake controller input current [A] = 0.5 A + switching current [A]

- ▶ Set the switch for voltage reduction to 1.

The voltage reduction function is described in "Braking function with TL HBC", page 6-3.

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External capacitors

The power control can store superfluous braking energy on an external electrolytic capacitor via the DC-Bus connection. This enables any increase in the DC-Bus voltage to be reduced in the event of frequent braking.

Only use cables with the following specifications:

	TLD011	TLD012
dielectric strength	≥ 450 V	≥ 450 V
external capacity	< 500 µF	< 1000 µF

Cable specification

- shielded cable
- shield grounded at both ends
- maximum cable length 3 m (118 in.)
- minimum cross-section: 1.5 mm^2 (16AWG)

Connection

▶ Connect the cable from the DC link connection to the capacitor connections. Observe correct polarity: DC+ to + and DC- to -. Otherwise the unit and capacitor can be destroyed.

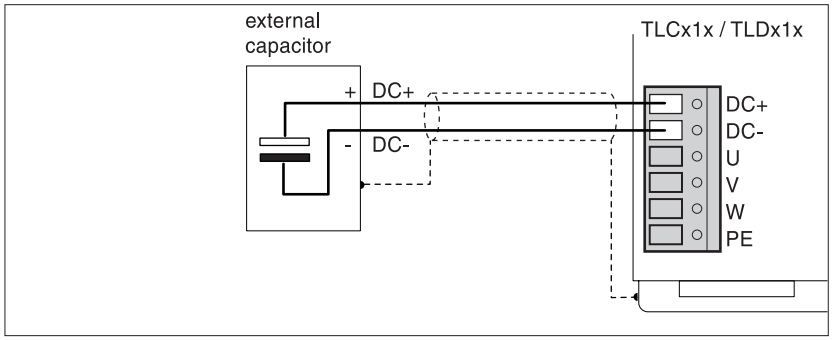

Fig. 4.23 Connection of an external capacitor

4.5 Wiring example

4.5.1 Stepper motor controller without speed monitoring

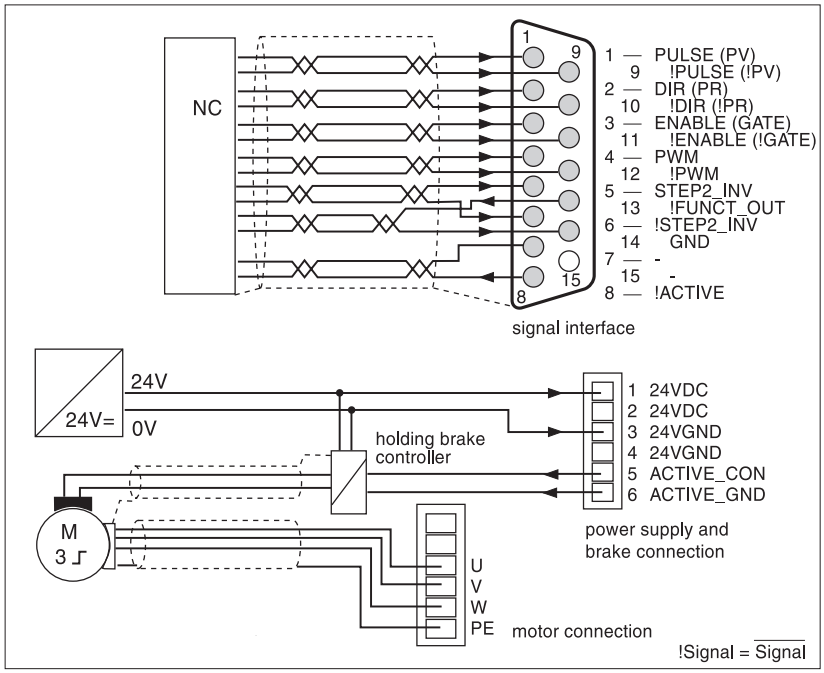

Fig. 4.24 Wiring example for stepper motor controller

Signal interface:

Pin	Signal	Active	Meaning	I/O
1/9	**PULSE (PV)** [1)]	high/low	Pulse signal or pulse forward signal	I
2/10	**DIR (PR)**[1)]	high/low	Direction signal or pulse backward signal	I
3/11	**ENABLE (GATE)**[1)]	high/low	Enable signal for power amplifier, DIP switch 5 to OFF	I
4/12	PWM	high/low	Phase current value	I
5/6	STEP2_INV	high/low	Angular resolution, inversion of DIP switch setting	I
7,14,15	**GND**[1)]	-	Ground	I
8	$\overline{\text{ACTIVE}}$	low	Drive ready	O
13	$\overline{\text{FUNCT\_OUT}}$	low	Following error message	O

1) Minimum pin assignment of signal interface for commissioning

Power supply and brake connection:

Pin	Signal	Active	Meaning	I/O
1.2	**24VDC** [1)]	-	+ 24 V_{DC} power supply	I
3.4	**24VGND**[1)]	-	GND for 24 V_{DC} power supply	I
5	ACTIVE_CON	high	Drive ready, brake/relay control signal	O
6	ACTIVE_0V	-	GND for brake and relay control voltage	O

1) Minimum pin assignment of signal interface for commissioning

TLADOCD01ME, -002, 12.02

4.6 Check wiring

▶ Carry out these checks:

- Are all cables and connectors safely installed and connected?
- Are any live cable ends exposed?
- Are the control lines connected correctly?

System check and initialization

The motor must not be controlled for the wiring test.

⚠WARNING

UNINTENDED EQUIPMENT ACTION

Destruction of motor! The motor must only be operated with the correct phase current. Controlling the motor with excessively high phase current will destroy the motor immediately.

Failure to follow these instructions can result in death, serious injury or equipment damage.

▶ Remove the plug for the PULSE-C interface to test the wiring.

▶ Select the ENABLE(GATE) function with DIP switch to OFF.

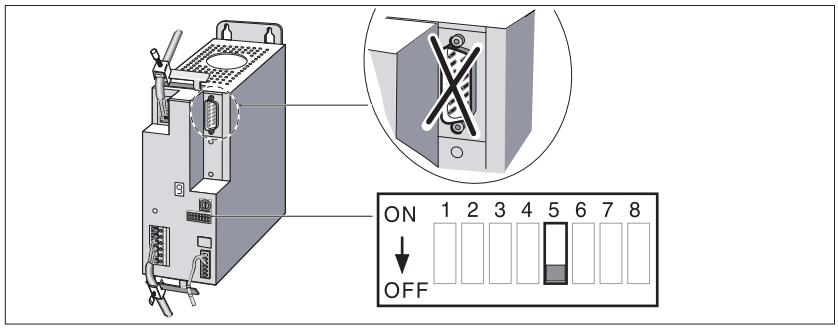

Fig. 4.25 Wiring test without PULSE-C plug; DIP 5 ENABLE to OFF

▶ Switch on the primary power supply.

▶ Switch on the 24 V power supply.

Unit OK

The status display first changes from "1" to "2", then to "3".

The unit carries out a self-test and checks the internal operating data, the internal monitoring devices and the connected sensing equipment.

The DC link is loaded. The DC link LED D2 lights.

▶ Switch off the power supply again.

▶ Connect the PULSE-C plug again for commissioning.

4.7 Installation troubleshooting

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION

- Read and understand this bulletin in its entirety before installing or operating Twin Line drive system products. Installation, adjustment, repair, and maintenance of these drive systems must be performed by qualified personnel.
- Disconnect all power before servicing the power controller. WAIT SIX MINUTES until DC bus capacitors discharge, then measure DC bus capacitor voltage between the DC terminals to verify that the DC voltage is less than 45 V. The DC bus LED is not an accurate indication of the absence of DC bus voltage.
- The stepper can produce voltage at its terminals when the shaft is rotated! Prior to servicing the power controller, block the stepper shaft to prevent rotation.
- DO NOT short across DC bus terminals or touch unshielded components or terminal strip screw connections with voltage present.
- Install all covers and close enclosure door before applying power or starting and stopping the drive system.
- The user is responsible for conforming to all applicable code requirements with respect to grounding all equipment. For drive grounding points, refer to Fig.1.5 on page 1-5.
- Many parts in this drive system, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.

Before servicing drive system:

- Disconnect all power.
- Place a “DO NOT TURN ON” label on the drive system disconnect.
- Lock the disconnect in open position.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Operational status indicator "2"

If the drive hangs in the switching-on state "2", this indicates an internal fault in the unit which can only be identified and corrected by your local representative.

Operational status indicator "3"

If the display does not change from "3" to "4", check whether the mains voltage is switched on and the mains voltage connections are correctly wired.

Operational status indicator flashing

The unit has detected a fault. In "Diagnosis and troubleshooting" from page 7-1 a list of the causes of faults can be found.

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5 Commissioning

5.1 Commissioning procedure

The following commissioning steps are also required if the user is using a configured unit under changed operating conditions. Incorrectly set values could cause permanent damage to the drive, motor and system parts.

What needs to be done...	Info
Make sure the Twin Line unit is correctly installed and wired up. When carrying out this check, use the wiring diagrams for the system layout or the sample circuits in "Wiring example", page 4-32.	Chapter "Installation" from page 4-1
Setting phase current	Page 5-5
Set DIP switch	Page 5-6
Check the functioning of the holding brake controller if it is wired for that	Page 5-9
Test run	Page 5-10
Optimizing the movement behavior of the motor	Page 5-11

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5.2 Safety instructions

Commissioning may only be carried out by qualified personnel with a knowledge of automatic control engineering.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

Twin Line controllers are software driven devices that require programming and parameter adjustments for proper operation. Incorrectly set parameters or programming steps can cause unintended actions.

- Verify operation of the machinery after programming and after programming changes.
- Verify operation of the controller after changing parameter settings.
- If possible, verify critical circuits, initial parameter adjustments, and programming instructions with the motor disconnected from the driven machinery. Once initial verification is complete, reconnect the motor and verify the operation of the overall system.
- If the controller is replaced or changed, it is necessary to reprogramming the parameters and the program.

If controller verification is done with a stand-alone test motor, the motor frame must be securely anchored to prevent unintended movement or toppling during rapid acceleration or deceleration.

Failure to follow these instructions can result in death, serious injury or equipment damage.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

P/D signal inputs serve as setpoint inputs for position commands. Unintended equipment operation may occur, if signals are incompletely or incorrectly wired or improper signal levels are applied to the signal inputs.

- Verify the Twin Line unit is correctly and completely wired.
- Verify proper signal levels applied to the signal inputs.
- If possible, verify operation modes with the motor disconnected from the driven machinery. Once initial verification is complete, reconnect the motor and verify operation of the overall system.

If controller verification is done with a stand-alone test motor, the motor frame must be securely anchored to prevent unintended movement or toppling during rapid acceleration or deceleration.

Failure to follow these instructions can result in death, serious injury or equipment damage.

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⚠ WARNING

LOSS OF CONTROL

- The designer of any control scheme must consider the potential failure modes of the control signal paths and, for certain critical control functions, provide a means to achieve a safe state during and after a signal path failure. Refer to NEMA ICS1.1 *Safety Guidelines for the Application, Installation and Maintenance of Solid State Control* and NEMA ICS7.1 *Safety Standards for construction and Guide for Selection, Installation and Operation of Adjustable –Speed Drive Systems* for further information
- System control signal paths may include communication links. Consideration must be given to the implications of unanticipated transmission delays or failure of the link.

Failure to follow these instructions can result in death, serious injury or equipment damage.

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⚠WARNING

LOSS OF CONTROL

No driving torque, electrical braking, or holding torque is available from the motor during loss of mains power, controller faults of error class 3 or error class 4, drive overloading or during hardware failure.

- Availabiltiy of sufficient braking torque for rapid stopping requires that the drive be properly tuned and, if required, fitted with a suitable ballast resistor for dynamic braking. Refer to the appropriate sections of this instruction manual for setting the Quick Stop function and the dimensioning of ballast resistors.
- Verify all electrical and mechanical braking functions for proper sequencing, sufficient torque production and braking capacity prior to verifying critical machine movements that require an operational braking system.
- It is recommended to verify veloctiy and motion profiles / movements of the machine travel where loss of braking would not result in a collision or activating the mechanical stop.
- Verification of braking system should be performed with the most demanding duty cycle which needs the maximum braking torque and for the routine duty cycle.
- When required (i.e. protection of personnel) use a separate braking function for holding or stopping torque. Refer to NEMA ICS7.1 *Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable –Speed Drive Systems* for additional information.
- Verify all braking systems for suitability of application (i.e. capacity, redundancy, stopping versus holding) based on applicable machinery standards.
- Ensure there is no overloading caused by short-time load impact.

Failure to follow these instructions can result in death, serious injury or equipment damage.

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5.3 Commissioning the drive

⚠WARNING

MACHINE MOTION HAZARD

During operation, keep all personnel and material out of the motion hazard zone surrounding th emoving parts of the machine!.

Failure to follow these instructions can result in death, serious injury or equipment damage.

5.3.1 Setting phase current

The drive controls the motor torque with the phase current. A high phase current generates a high motor torque. To prevent damage to the motor, the maximum permissible phase current at the unit must be limited.

⚠WARNING

UNINTENDED EQUIPMENT OPERATION
Phase current that is set too high can damage or destroy the motor!

The phase current at the unit must not be set higher than the rated phase current of the motor. If no value for the rated current is given, select the next lower phase current on the unit.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Rotary switch Phase current

Fig. 5.1 Setting phase current

▶ Select the rotary switch position for the maximum phase current from the table.

Rotary switch	r.m.s. value of the max. phase current [A]	
	TLD011	TLD012
0	0.40	1.75
1	0.50	2.00
2	0.60	2.25
3	0.70	2.50

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Rotary switch	r.m.s. value of the max. phase current [A]	
	TLD011	TLD012
4	0.80	2.75
5	0.90	3.00
6	1.00	3.25
7	1.20	3.50
8	1.40	3.75
9	1.60	4.00
A	1.80	4.25
B	2.00	4.50
C	2.25	4.75
D	2.50	5.00
E	2.75	6.00
F	3.00	7.00

5.3.2 Set DIP switch

The DIP switch is used to set control signals for current reduction, enabling the power amplifier, pulses and speed monitoring.

DIP 1, 2 and 3 Increment count

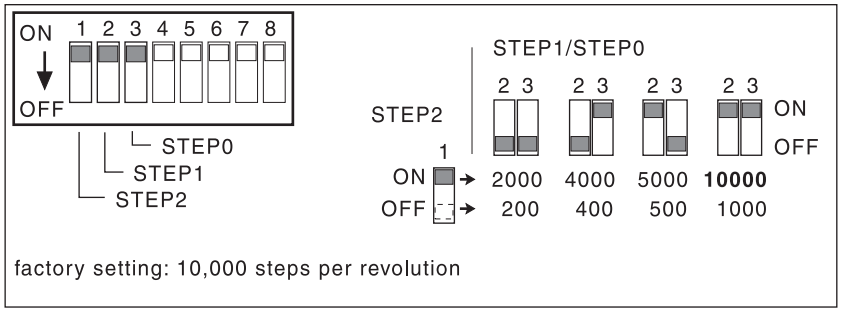

Fig. 5.2 Setting increment count

Setting increment count

▶ Set the increment count with DIP switches 3, 2 and 1. The increment count that you selected with STEP0 and STEP1 can be increased by 10 times with STEP2.

The STEP2 setting can be inverted with the PULSE-C interface STEP2_INV input signal. See page 4-25 for the signal settings.

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DIP 4 and 5 Current reduction and ENABLE/GATE function

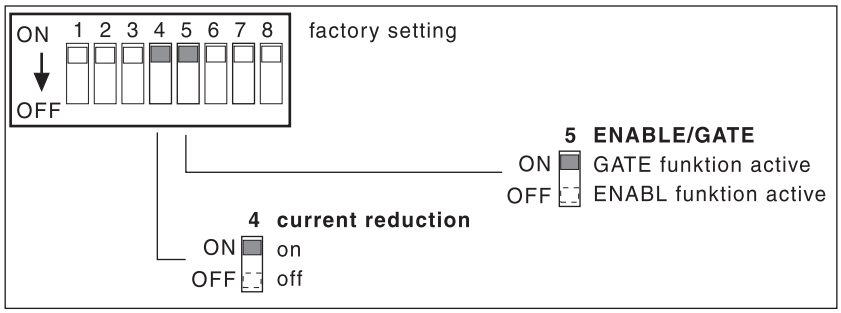

Fig. 5.3 Setting current reduction and ENABLE/GATE function

Current reduction Current reduction reduces the motor current to approximately 70% 100 ms after the last pulse slope is received. This allows the motor to cool while at a standstill.

If the motor drives a vertical axis, the current reduction may result in loads sinking because the torque is reduced to about 70% along with the phase current.

ENABLE (GATE)

The ENABLE (GATE) signal at the signal interface can carry out two functions:

- ENABLE function: enable and disable power amplifier, DIP 5 = OFF
- GATE function: enable and disable pulse input, DIP 5 = ON

An error message is also acknowledged with a positive slope at the ENABLE/GATE input.

In a multi-axis system the GATE function enables switching between individual axes by enabling the pulses for the active axis and leaving them blocked for the remaining axes.

DIP 6 and 8

Pulse mode and speed monitoring

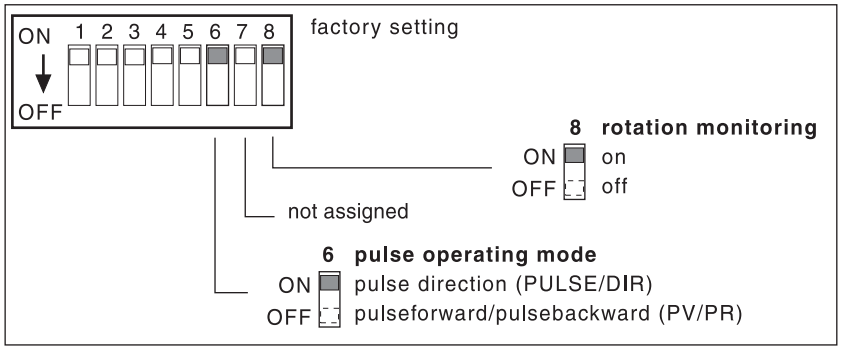

Fig. 5.4 Setting the function of the PULSE/DIR signals and speed monitoring

Pulse mode

The position setpoint values can be fed to the signal interface as a pulse-direction signal or as a pulse-forward and pulse-backward signal. The drive converts input signals to a motor movement in accordance with the DIP switch setting.

Only pulse/directions signals are evaluated in the unit without speed monitoring. The DIP switch setting is not relevant.

Speed monitoring

Speed monitoring can be disabled with the DIP switch. Then the unit no longer monitors following errors, even with persistent encoder signals.

The DIP switch setting is not relevant in the unit without speed monitoring.

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5.3.3 Checking the function of the limit switches

The motor traverse range can be secured with limit switches. The limit switch signals must be monitored by the external controller and interrupted for power control if the setpoint pulses are triggered.

▶ Check the functioning of the limit switches before commissioning the motor in the system.

5.3.4 Checking the holding brake

⚠WARNING

MACHINERY MOTION HAZARD

Release of the motor brake can cause unintended machine movement.

- Block or clamp the machinery to prevent motion. Uncouple the motor from the machinery during the test. Once the test is completed, couple the motor and unblock /unclamp the machinery.
- During test, keep all personnel and material out of the motion hazard zone surrounding the moving parts of the machine!

Failure to follow these instructions can result in death, serious injury or equipment damage.

Carry out this test when you are using a motor with a holding brake.

Check the brake function with the push-button switch on the holding brake controller.

If the holding brake controller is to enable the button, the controller must not be switched by the drive:

▶ Disconnect the ACTIVE_CON control cable at the drive or switch off the 24 V supply to the drive.

▶ Press the button on the holding brake controller several times to alternately release and re-apply the brake. The LED on the controller will light up when the brake has been activated and thereby released.

▶ Check the brake function: the shaft can be moved by hand when the brake is not applied, but not when the brake is applied.

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5.3.5 Motor test run

⚠WARNING

UNINTENDED EQUIPMENT ACTION

Danger of injury and damage to system parts resulting from unexpected motor acceleration.

- Run the first test run with no coupled load. If the motor is already installed in the plant, ensure that any unexpected motor movements will not cause any damage.

Failure to follow these instructions can result in death, serious injury or equipment damage.

Checking motor direction of rotation

▶ Switch on the external 24 V_{DC} power supply and the 230 V power for the power circuit.

▶ Enable the ENABLE signal if the ENABLE function has been selected with DIP switch 5=OFF.

The operational status indicator changes to "6". Power amplifier is enabled.

▶ Start the first test with low pulse frequency. If the DIR signal is disabled, the motor must rotate in the clockwise or positive direction.

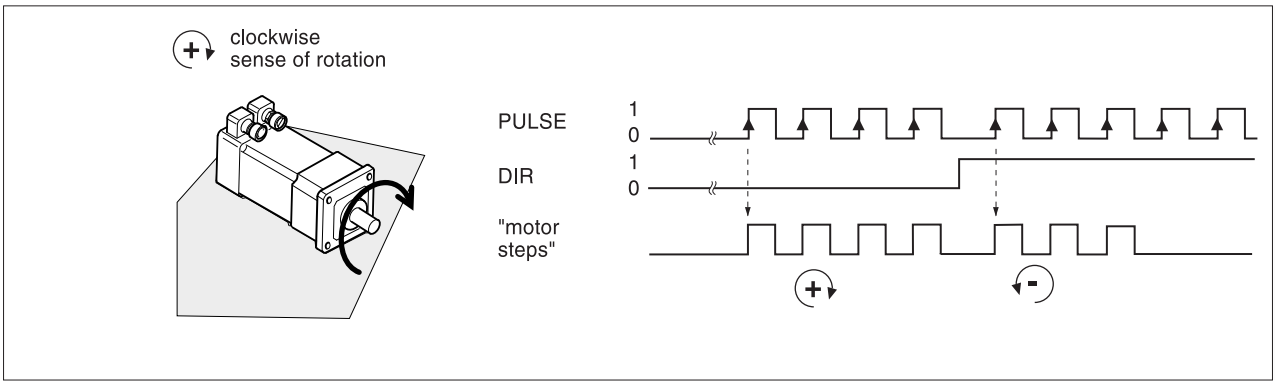

Fig. 5.5 Direction of rotation of motor

In the model without encoder the motor direction of rotation can be reversed by switching two motor phases.

If the motor follows the pulse signals, the control of the motor is correct.

▶ Switch off the power supply and install the motor in the system.

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5.3.6 Optimizing the movement behavior of the motor

Calculating and testing cut-off frequencies

For optimum operation of the motor with the drive the cut-off frequencies must be set for the start/stop and the acceleration phase at the NC controller.

The cut-off frequencies of a motor are determined from the motor torque and the external moment of inertia from the characteristic curve diagram of the stepper motor.

▶ Calculate the moment of inertia of the system reduced to the axis.

▶ Use the characteristic diagram of the motor and the motor torque to calculate the values for the

- maximum start-stop frequency
- the slope of the frequency ramp

Start-stop frequency

The unloaded motor accelerates without stepping errors from standstill with the start-stop frequency. If the motor is subject to external inertial forces, a lower frequency than the start-stop frequency must be selected.

The same applies for the cut-off frequency for braking the motor to speed 0.

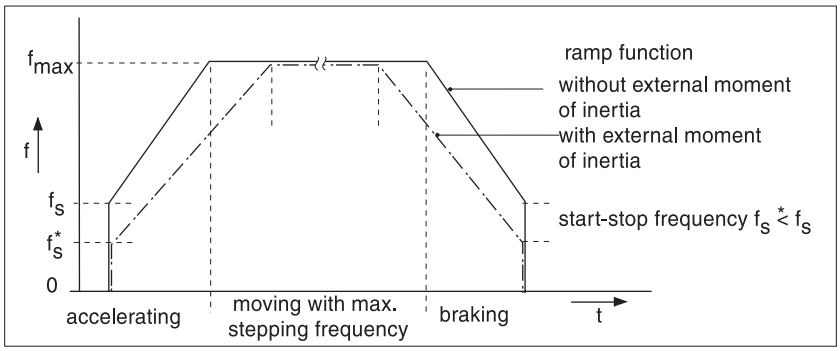

Fig. 5.6 Characteristics of the linear ramp with and without external moments of inertia

The pulse frequency must be limited to the start-stop frequency before reversion of the direction of rotation so the change of direction can be executed without increment loss.

Frequency ramp

In the acceleration and braking range above the start-stop frequency the control frequency must be continuously changed corresponding to the frequency ramp. The slope of the frequency ramp depends on the external moment of inertia and the motor type.

▶ Program the frequency data into the NC or positioning controller and start a test run under actual load conditions.

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6 Operating functions

6.1 Positioning mode

⚠WARNING

UNINTENDED EQUIPMENT OPERATION

P/D signal inputs serve as setpoint inputs for position commands. Unintended equipment operation may occur, if signals are incompletely or incorrectly wired or improper signal levels are applied to the signal inputs.

- Verify the Twin Line unit is correctly and completely wired.
- Verify proper signal levels applied to the signal inputs.
- If possible, verify operation modes with the motor disconnected from the driven machinery. Once initial verification is complete, reconnect the motor and verify operation of the overall system.

If controller verification is done with a stand-alone test motor, the motor frame must be securely anchored to prevent unintended movement or toppling during rapid acceleration or deceleration.

Failure to follow these instructions can result in death, serious injury or equipment damage.

The drive moves a stepper motor in accordance with a setpoint. The setpoint signal is generated by a positioning or NC controller and fed to the PULSE-C interface as a pulse signal.

If speed monitoring is also installed and enabled by DIP switch, the drive records the position of the motor and reports increment losses, which may occur as a result of blocking or overload of the motor.

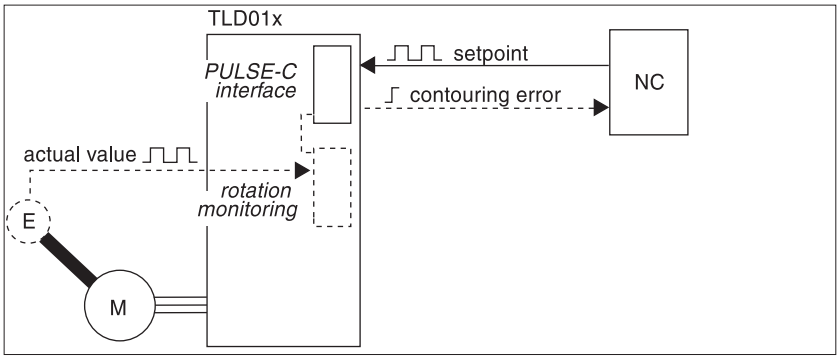

Fig. 6.1 Positioning controller of a stepper motor with speed monitoring

Setpoint value The setpoint value is sent as pulse-direction signal "P/D". If an encoder connection is installed, the setpoint value can be preset as pulse forward/pulse backward signal "$Pulse_{forward}$/$Pulse_{backward}$".

6.2 Functions of the drive

6.2.1 Monitoring functions

Different monitoring systems protect the motor and power amplifier from overload and overheating and detect drive position deviations. You will find an overview of all monitoring functions in "Safety devices" on page 2-6.

The 7-segment display of the drive shows error messages and warnings as flashing signals.

Temperature monitoring

Sensors in the drive measure the temperature of the power amplifier. If an encoder connection is installed, the operating temperature of the motor can be recorded and monitored over the encoder cable.

If the temperature of the motor or power amplifier exceeds the permissible limit temperature for more than five seconds, the drive shuts off the power amplifier and reports a temperature error.

Following error

If speed monitoring is installed, the angular position of the motor is transferred incrementally over the connection with A/B rectangular signals. The unit detects stepper errors by comparison with the setpoint position and reports a following error if the limit value of 6.4° is exceeded.

Error message over the PULSE-C interface

A following error can be reported to the NC controller over the FUNCT_OUT output of the PULSE-C interface. The power amplifier is blocked simultaneously and the ACTIVE switches to high.

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6.2.2 Braking function with TL HBC

In motors fitted with a holding brake the brake prevents unintended movement of the motor when not under power. The drive controls the holding brake directly or with the TL HBC holding brake controller, which is available as an accessory.

Holding brake controller

The TL HBC holding brake controller amplifies the ACTIVE_CON control signal from the signal interface, and controls the brake in such a way that it responds quickly whilst generating as little heat as possible.

The holding brake can be released with the push-button switch fitted to the holding brake controller for commissioning and function tests.

Braking signals

ACTIVE_CON switches to "high" and opens the brake as soon as the power amplifier is enabled and the motor has holding torque.

I/O signal	Function	Value
ACTIVE_CON	Brake will be opened or is open	high
ACTIVE_CON	Brake will be applied or is applied	low

Voltage reduction

The control voltage of the holding brake controller is variable when the voltage drop is activated. The voltage is then 24 V for approx. 100 ms and afterwards falls back to its holding voltage of 12 V.

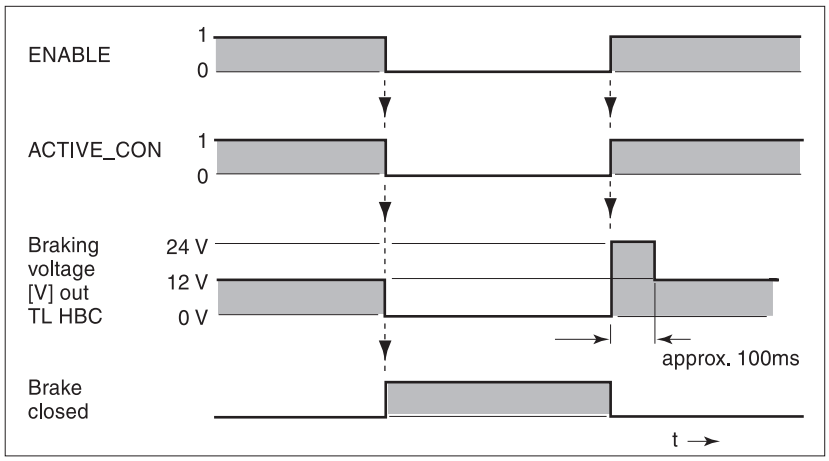

Fig. 6.2 Time diagram, brake function with voltage reduction on

When the power is switched on, the holding brake control system and the button function are reset. No voltage is present on the control terminals of the brake, and the control system LED is off.

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7 Diagnosis and troubleshooting

7.1 Operational status indicators and transitions

Status display in the unit

The D2 LED on the motor plug lights when there is power in the DC link.

The 7-segment display shows the operating states of the drive in coded form.

Display	Operating status
0	24 V switched on
1	Initialization of the unit electronics
2	The power amplifier is not ready to switch on
3	Switching on the power amplifier is disabled
4	The power amplifier is ready to switch on
6	The unit is working in the selected mode
7	A Quick-Stop is being executed
8, 9	An error has been detected and the error response activated
0 - A flashing	Indicates an error value

Operating transitions

The conditions for changing between the operating states displayed and the response of the drive to an error follow a fixed sequence.

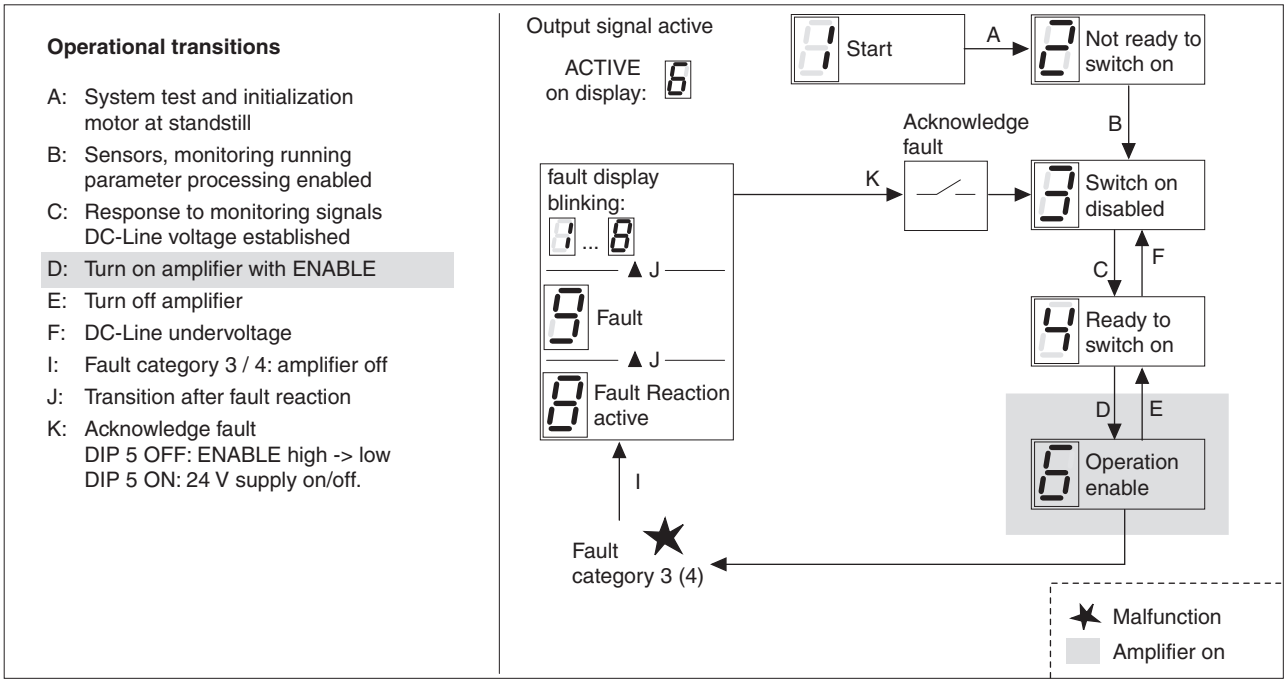

Fig. 7.1 Operating states and transitions of the drive

7.2 Error display and rectification

Error display

The cause of an operating malfunction is displayed

- by a flashing number in the seven-segment display
- by the error response of the drive and motor

Resetting error messages

When the fault is corrected, the message can be acknowledged by return of the ENABLE signal to the signal interface. DIP switch 5 must be set to OFF.

If DIP switch 5 is set to ON, the GATE function is enabled. In this case an error message can only be acknowledged by briefly switching off the 24 V power supply.

Error response

The drive triggers an error response when a malfunction occurs. Depending on the seriousness of the fault, the unit responds in accordance with one of the following error classes:

Error class	Response	Meaning
0	Warning	Message only, no interruption to movement operations
3	Fatal error	The power amplifier and controller switch off. The unit can only be reactivated after the error has been corrected.
4	Uncontrolled operation	The power amplifier and controller switch off. The error response can only be reset by switching off the unit.

Error rectification

Display	Error	Error class	Cause	Troubleshooting
dark	Display dark	-	No power supply	Check power supply and fuses
	Display dark	-	Power supply wrongly connected	Connect properly
1	Undervoltage	3	DC link voltage below threshold value for switching off the drive	Check line voltage and check connections to unit
2	Following error	3	Drive blocked; start-stop frequency too high; movement frequency or acceleration too high	Reduce load or motor torque check settings for motor current set start-stop frequency lower; reduce movement frequency or acceleration
2	Maximum motor speed	3	Maximum motor speed exceeded	Reduce pulse frequency
3	Motor cable	3	Short circuit or ground fault in motor cable	Check connections, replace motor cable
4	Position sensor	3	Only with TLD01x with speed monitoring: encoder or encoder cable defective	Check encoder cable and encoder. Replace cable, replace motor
5	Overvoltage	3	DC link overvoltage	Use external capacitor
7	Power amplifier overtemperature	3	The power amplifier is overheating	Reduce load, use current drop to reduce power
7	Motor overtemperature	3	Only with TLD01x with encoder connection: motor overheating Temperature sensor not connected or defective	Allow motor to cool, use a motor with a higher rated power, use current drop to reduce power, check or replace motor encoder cable

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Display	Error	Error class	Cause	Troubleshooting
8	Watchdog	4	Internal system error	Switch unit off and on, replace unit
C	Timing error	4	Timing of GATE, STEP2_INV or PULSE not retained	Checking timing response of signals at PULSE-C interface.

7.3 Malfunctions in movement mode

Faults	Cause	Correction
Motor does not rotate and has no holding torque	Signal input PWM: high	Disable current controller (PWM)
	Signal input ENABLE: low	Enable power amplifier release (ENABLE)
	Motor incorrectly connected	Connect motor correctly
Motor does not rotate but has holding torque	Signal input GATE: high	Disable GATE signal with GATE function to release pulses
	Pulse frequency	Check timing and signal voltage level of pulse signals (PULSE, DIR)
Motor does not rotate uniformly	Pulse frequency	Check timing and signal voltage level of pulse signals (PULSE, DIR)
	Overload	Reduce load
	Motor defective	Replace motor
Motor rotates in the wrong direction	The motor phases are swapped	Check motor connection, replace
	+DIR/-DIR incorrectly connected PV/PR signals swapped	Check signals, connect correctly
Motor torque too low	Phase current wrongly set	Set motor phase current as required by motor type label and phase current table at commissioning

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8 Service, Maintenance and Warranty

8.1 Service Information

Technical and commercial service requests, including warranty and on-site services, should be directed to your Schneider Electric authorized distributor or the Schneider Electric Customer Support Center at 1-888-SQUARED (1-888-778-2733).

Maintenance

The Twin Line controller requires no maintenance.

- ▶ Periodically check the control cabinet filter at the TLD unit's location. Inspection intervals are determined by ambient conditions at the site.

Repairs to the TLD unit are to be carried out only by Schneider Electric authorized personnel.

Warranty

Unauthorized disassembly of the controller will void the warranty.

8.2 Shipping, storage and disposal

⚠ DANGER

HAZARD OF ELECTRIC SHOCK, BURN, OR EXPLOSION

- Read and understand this bulletin in its entirety before installing or operating Twin Line drive system products. Installation, adjustment, repair, and maintenance of these drive systems must be performed by qualified personnel.
- Disconnect all power before servicing the power controller. WAIT SIX MINUTES until DC bus capacitors discharge, then measure DC bus capacitor voltage between the DC+ and DC- terminals to verify that the DC voltage is less than 45 V (see Fig. 1.5 on page 1-5). The DC bus LED is not an accurate indication of the absence of DC bus voltage.
- The stepper can produce voltage at its terminals when the shaft is rotated! Prior to servicing the power controller, block the stepper shaft to prevent rotation.
- DO NOT short across DC bus terminals or touch unshielded components or terminal strip screw connections with voltage present.
- Install all covers and close enclosure door before applying power or starting and stopping the drive system.
- The user is responsible for conforming to all applicable code requirements with respect to grounding all equipment. For drive controller grounding points, refer to Fig. 1.5 on page 1-5.
- Many parts in this drive system, including printed wiring boards, operate at line voltage. DO NOT TOUCH. Use only electrically insulated tools.

Before servicing drive system:

- Disconnect all power.
- Place a “DO NOT TURN ON” label on the drive system disconnect.
- Lock the disconnect in open position.

Failure to follow these instructions can result in death, serious injury or equipment damage.

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Deinstallation

- ▶ Switch the unit off.
- ▶ Disconnect the power supply.
- ▶ Mark all connections to the unit.
- ▶ Disconnect the motor cable.
- ▶ Pull out the interface connector.
- ▶ Remove the unit from the control cabinet.

Shipping The unit must be protected against impact while in transit. Use the original packing material for this purpose.

Storage Store the unit within the specified storage limits for room temperature and humidity.

Protect the unit from dust and dirt.

Disposal When servicing or decommissioning, dispose of this equipment in accordance with the applicable standards for this classification of equipment. The drive is made from many recyclable materials. Some materials may require special disposal procedures.

For recycling purposes, split the unit into the following parts

- Housing, screws and terminals for ferrous metal recycling
- Cables for copper recycling
- Connectors, hood for plastics recycling

Circuit boards and electronic components must be disposed of separately in accordance with the relevant environmental protection laws. Check with and conform to local laws and procedures before disposing of these components.

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9 Accessories and spare parts

9.1 List of accessories

Accessories for the drive are:

Qty.	Designation	Order no.
1	Connector set for complete assembly	TLATF
1	Motor cable 1.5 mm^2	TLACPVAAxxx1 [1]
1	Pulse direction cable for PULSE-C interface 2 x socket, 15-pin 1 x socket, 15-pin, one end open	 TLACDCBByyy [2] TLACDCAByyy [2]
1	Encoder cable for speed monitoring with SUB-D connector at both ends	 TLACFVBAxxx1 [1]
1	Holding brake controller TL HBC	TLABHO
1	External mains filter for units without internal filters TLDx11D\TLDx12D	Please contact your local Schneider Electric office

1) Cable length xxx: 003, 005, 010, 015, 020, 3 m, 5 m, 10 m, 15 m, 20 m, longer cables onrequest. Please contact your local Schneider Electric office.
2) Cable length yyy: 005, 015, 030, 050, 100: 0.5 m, 1.5 m, 3 m, 5 m, 10 m.

9.2 List of spare parts

Drive

Qty.	Designation	Order no.
1	TLDx11, TLDx12	Type code
1	SK14 shielding terminal	TLATE

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10 Drive label

10.1 Illustration of the drive label

▶ Copy the unit label and stick it on the inside of the Twin Line unit's hood.

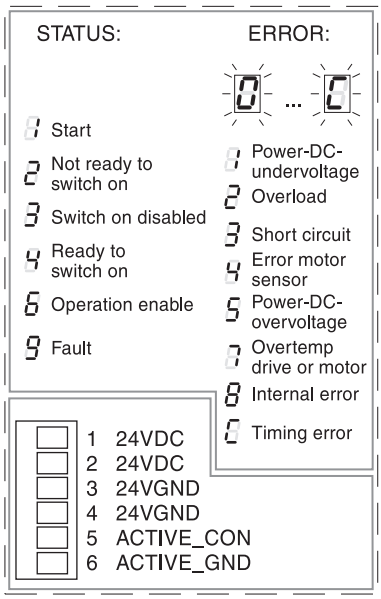

Fig. 10.1 Unit label

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